164

P.V.

TRANSCRIPT OF RECORD

Supreme Court of the United States

OCTOBER TERM, 1941

No. 323

MUNCIE GEAR WORKS, INC., AND BRUNS & COLLINS, INC., PETITIONERS,

vs.

OUTBOARD, MARINE & MANUFACTURING COMPANY, AND JOHNSON BROTHERS ENGINEERING CORPORATION

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE SEVENTH CIRCUIT.

PETITION FOR CERTIORARI FILED JULY 31, 1941.

CERTIORARI GRANTED OCTOBER 13, 1941.

IN THE

Supreme Court of the United States

October Term, A. D. 1941.

No.

MUNCIE GEAR WORKS, INC., and BRUNS & COLLINS, INC.,

Petitioners,

vs.

OUTBOARD MARINE & MANUFACTURING COMPANY and JOHNSON BROTHERS ENGINEERING CORPORATIONS,

Respondents.

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE SEVENTH CIRCUIT.

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TRANSCRIPT OF RECORD

IN THE

United States Circuit Court of Appeals
For the Seventh Circuit

No. 7388

OUTBOARD MARINE & MANUFACTURING COMPANY AND JOHNSON BROTHERS ENGINEERING CORPORATIONS,

Plaintiffs-Appellants,

vs.

MUNCIE GEAR WORKS, INC., AND BRUNS & COLLINS, INC.,

Defendants-Appellees.

Appeal from the District Court of the United States for the Northern District of Illinois, Eastern Division.

TRANSCRIPT OF RECORD FILED JULY 9, 1940.
PRINTED RECORD.

IN THE

United States Circuit Court of Appeals

For the Seventh Circuit

No. 7388

OUTBOARD MARINE & MANUFACTURING COMPANY AND JOHNSON BROTHERS ENGINEERING CORPORATIONS,

Plaintiffs-Appellants,

vs.

MUNCIE GEAR WORKS, INC., AND BRUNS & COLLINS, INC.,

Defendants-Appellees.

Appeal from the District Court of the United States for the Northern District of Illinois, Eastern Division.

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Plaintiff's Witnesses.

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PLAINTIFF'S EXHIBITS.

DEFENDANT'S EXHIBITS.

UNITED STATES LETTERS PATENT.

1 Pleas in the District Court of the United States for the Northern District of Illinois, Eastern Division, begun and held at the United States Court Room, in the City of Chicago, in said District and Division, before the Honorable John P. Barnes, District Judge of the United States for the Northern District of Illinois on Twenty-first day of February, in the year of our Lord one thousand nine hundred and Forty, being one of the days of the regular February Term of said Court, begun Monday, the Fifth day of February, and of our Independence the 164th year. Placita.

Present:

Honorable John P. Barnes, District Judge.
William H. McDonnell, U. S. Marshal.
Hoyt King, Clerk.

2 IN THE DISTRICT COURT OF THE UNITED STATES,

Northern District of Illinois,

Eastern Division.

Outboard, Marine & Manufacturing Company, a corporation of Delaware, *vs.* Muncie Gear Works, Inc., a corporation of Indiana, and Bruns & Collins, Inc., a corporation of Illinois.	No. 273.

Be It Remembered, that the above-entitled action was commenced by the filing of the following Bill of Complaint in the above-entitled cause, in the office of the Clerk of the District Court of the United States for the Northern District of Illinois, Eastern Division, on this the 19th day of January, A. D. 1939:

Filed Jan. 19, 1939.

3 IN THE UNITED STATES DISTRICT COURT,

Northern District of Illinois,

Eastern Division.

Outboard, Marine & Manufacturing Company, a corporation of Delaware, *Plaintiff*, *vs.* Muncie Gear Works, Inc., a corporation of Indiana, and Bruns & Collins, Inc., a corporation of Illinois, *Defendants.*	Civil Docket. No. 273.

COMPLAINT SEEKING EQUITABLE RELIEF.

To the Honorable the Judges of the United States District Court for the Northern District of Illinois, Eastern Division:

I. Plaintiff.

The Plaintiff Outboard, Marine & Manufacturing Company, is a corporation duly organized and existing under

and by virtue of the laws of the State of Delaware, and has its principal office at Wilmington, Delaware.

II. Defendants.

Defendant Muncie Gear Works, is a corporation duly organized and existing under the laws of the State of Indiana and has its principal office and place of business at Muncie, Indiana.

Defendant Bruns & Collins, Inc., is a corporation duly organized and existing under the laws of the State of Illinois, having its principal office and place of business at 2532 South Cottage Grove Avenue at Chicago, Illinois.

4 III. Jurisdiction.

The jurisdiction of this Court is based on the patent laws of the United States of America. The acts of infringement hereinafter complained of were and are being committed at Muncie, Indiana, Chicago, Illinois, within this District, and elsewhere within the United States.

IV. Patents in Suit.

The Plaintiff Outboard, Marine & Manufacturing Company, is the owner of the following United States Letters Patent:

Pierce Re. 18,118 duly and legally issued July 7, 1931.

Evinrude 1,786,835 duly and legally issued Dec. 30, 1930.

Irgens 1,869,749 duly and legally issued Aug. 2, 1932.

Irgens 1,802,652 duly and legally issued Apr. 28, 1931.

Arndt 1,875,912 duly and legally issued Oct. 31, 1933.

Ownership of the whole right, title and interest in each of the aforesaid patents other than Pierce Reissue 18,118 has been as above alleged throughout the period of infringement of each such patent hereinafter complained of. Pierce Reissue patent 18,118 was assigned to Plaintiff during the period of infringement together with all rights of action for recovery for past infringement. Proffert of said patents and the assignments on which Plaintiff claims title thereto, or duly certified copies thereof, is hereby made.

V. Infringement.

Defendants have within the last six years and prior to the filing of this bill of complaint jointly and severally infringed and still are infringing said Letters Patent and each thereof by making, selling and using, in defiance of the rights of Plaintiff, outboard motors embodying the respective patented inventions, and will continue to infringe unless enjoined by this court.

The claims of each said patent charged to be infringed by Defendants are as follows:

Pierce Re. 18,118—claim 19.
Evinrude 1,786,835—claims 1, 4, 5, 8, 9 and 10.
Irgens 1,869,749—claims 1 and 2.
Irgens 1,802,652—claim 5.
Arndt 1,875,912—claim 16.

VI. Notice.

All devices manufactured under said patents by authority of the Plaintiff have borne the required statutory notice of said patents and each of them, and Defendant Muncie Gear Works, Inc. has been notified in writing of said patents and its infringement of each of them, notwithstanding which said Defendants have persisted and continued in their infringement.

VII. Aggravation.

The infringement of Defendant Muncie Gear Works, Inc. has been willful and, for the purpose of unlawfully diverting to itself the demand for outboard motors created by the Plaintiff, the said Defendant has persistently and habitually copied improvements originated and developed by the Plaintiff.

VIII. Prayer.

Wherefore Plaintiff prays for a preliminary and final injunction against further infringement by each Defendant and those in privity with each Defendant as to said patents and each of them, for an accounting for profits and damages to the full amount authorized by law, for an assessment of costs against Defendants, and

for such other and further relief as the Court may deem just.

Outboard, Marine & Manufacturing Company,
Plaintiff,
By S. L. Wheeler,
Counsel for Plaintiff,
Mariner Tower,
Milwaukee, Wisconsin.

Geo. L. Wilkinson,
Attorney for Plaintiff,
Address: First National Bank Bldg.,
Chicago, Illinois.

10 And on, to wit, the 17th day of February, A. D. 1939, came the Defendants by their attorneys and filed in the Clerk's office of said Court their certain Answer in words and figures following, to wit: Filed Feb. 17, 1939.

11 In the United States District Court,

Northern District of Illinois,

Eastern Division.

Outboard, Marine & Manufacturing Company, a corporation of Delaware, *Plaintiff,* *vs.* Muncie Gear Works, Inc., a corporation of Indiana, and Bruns & Collins, Inc., a corporation of Illinois, *Defendants.*	Civil Docket. No. 273.

ANSWER.

The defendants, Muncie Gear Works, Inc. and Bruns & Collins, Inc., answering the Complaint herein say:

1. Answering the allegations of part I of the Complaint.

The defendants are not advised save by the Complaint

as to the corporate existence of the plaintiff or where its principal office is located, and therefore deny the allegations respecting the same and leave plaintiff to its proof.

2. Answering part II of the Complaint.

Defendants admit that the defendant, Muncie Gear Works, Inc., is a corporation duly organized and existing under the laws of the State of Indiana and has its principal office and place of business at Muncie, Indiana.

Defendants admit that the defendant, Bruns & Collins, Inc., is a corporation duly organized and existing under the laws of the State of Illinois, having its principal office and place of business at 2532 South Cottage Grove Avenue, Chicago, Illinois.

12 3. Answering part III of the Complaint.

Defendants admit that the jurisdiction of this court is based on the Patent Laws of the United States of America, but deny that any acts of infringement by either or both of them were or are being committed at Muncie, Indiana, or at Chicago, Illinois, or elsewhere within this district, or elsewhere within the United States.

4. Answering part IV of the Complaint.

Defendants are not advised save by the Complaint that plaintiff Outboard, Marine and Manufacturing Company is the owner of the following United States Letters Patent:

Pierce Re. 18,118 issued July 7, 1931.
Evinrude 1,786,835 issued Dec. 30, 1930.
Irgens 1,869,749 issued Aug. 2, 1932.
Irgens 1,802,652 issued Apr. 28, 1931.
Arndt 1,875,912 issued Oct. 31, 1933.

or that ownership of the whole right, title and interest of each of the aforesaid patents other than Pierce Re. 18,118 has been as alleged throughout the entire period of alleged infringement of each of said patents, or that Pierce Re. Patent No. 18,118 was assigned to plaintiff during the period of alleged infringement together with all rights of action for recovery for past infringement, and defendants therefore deny these allegations and leave plaintiff to its proof.

Defendants deny that the said patents were duly and legally issued for the inventions which they respectfully claim.

5. Answering part V of the Complaint.

Defendants deny each and every allegation thereof.

13 6. Answering part VI of the Complaint.

Defendants are not advised save by the Complaint whether all or any devices manufactured under said patents by authority of the plaintiff have borne the required statutory notice of said patents, or each or any of them, and therefore deny the allegations respecting the same and leave plaintiff to its proof.

Defendants admit that the defendant, Muncie Gear Works, Inc., has been notified in writing of said patents in suit, and that infringement of each of them by said defendant has been alleged, but deny that notwithstanding said notice they have persisted and continued in infringement of the said patents; and further defendants deny that they have ever committed any act of infringement of said patents.

7. Answering part VII of the Complaint.

Defendants deny each and every allegation thereof.

Defenses.

8. First defense.

The defendants are informed and believe and therefore aver that each of the patents in suit is invalid and void because prior to the date of the alleged invention thereof, by the respective patentees of said patents in suit and more than two years prior to the filing of the applications for said patents, the alleged inventions or improvements described and claimed therein, and all material and substantial parts thereof, had been described in printed publications, among which are the patents and publications listed in the annexed schedule "A", which is a part hereof, and others, the dates and patentees, authors and publishers of which the defendants are now unable to supply but pray leave to add, by amendment to this Answer or otherwise, when they have more fully ascertained the same.

14 9. Second defense.

The defendants are informed and believe and therefore aver that each of the Letters Patent in suit was and is void and of no effect in law in that that alleged inventions or improvements described therein were invented by, or known to, or used by others in the United States, before the alleged inventions of the said patentees of the patents in suit and for more than two years prior to the respective applications for said patents; among which prior

inventors and users and those having prior knowledge are the patentees and their assigns of the several Letters Patent named in the annexed schedule "A", at the places and addresses named in said Letters Patent, and other prior inventors, users and those having prior knowledge the names of whom, and the times and places of such other public uses, being at the present time unknown to defendants, but which, when fully ascertained, defendants pray leave to insert in this Answer by amendment thereto.

10. Third defense.

The defendants are informed and believe and therefore aver that each of the said Letters Patent in suit is and was invalid and void because the alleged improvements purported to be patented thereby do not constitute patentable invention within the meaning of the Patent Laws of the United States, in view of the prior state of the art and in view of what was common knowledge on the part of those skilled in the art, all prior to the time of the alleged inventions by the respective applicants for said patents in suit, but involve merely the ordinary and expected skill of a person versed in the art to which said alleged improvements appertain.

11. Fourth defense.

Defendants are informed and believe and therefore aver that each of the Letters Patent in suit is invalid and void for the reason that the alleged inventions thereof purported to be patented thereby are not the same as were disclosed in the applications therefor, as originally filed, but are substantially different from any invention indicated, described or suggested in the original applications therefor; that the applications therefor were amended in the specification and claims during the prosecution thereof and the alleged patented subject matter is not supported by oath as required by law; that the said applications were unlawfully enlarged during the prosecution thereof; and that the claims of said Letters Patent are invalid and void for the reason that they include matter not shown or adequately described in the said patents.

12. Fifth defense.

Defendants are informed and believe and therefore aver that while the applications for the said patents in suit were pending in the United States Patent Office, the applicants therefor so limited and confined the claims of said applications under the requirements of the Commissioner of Patents that the plaintiff herein cannot now seek to obtain

construction for such claims sufficiently broad to cover any apparatus or device made, used or sold by these defendants.

13. Sixth defense.

Defendants are informed and believe and therefore aver that the claims of each of the Letters Patent in suit are wholly invalid and void as each of said claims is directed to an old and well known association of elements, and to old and well known practices, patentably exhausted
16 long prior to the inventions or improvements alleged to be covered by said claims, and further that the claims of each of the said patents in suit are wholly invalid and void as the same are for nonpatentable aggregations as distinguished from patentable combinations.

14. Seventh defense.

Defendants aver that they have not at any time infringed the said patents in suit or any of them, and that they are not now threatening and have no intention or plan in the future to make, use or sell outboard motors or devices of the alleged infringing kind, and that they are now manufacturing and selling outboard motors, and devices therefor, only of a construction which, as they are informed and believe and therefore aver, do not infringe the said patents in suit or any of them; and the defendants therefore, for these reasons and for the reasons set forth in the preceding paragraphs hereof, deny the equity of plaintiff's complaint and deny that plaintiff has any right to an accounting for profits, damages or costs to be recovered from these defendants, and they further deny any right of plaintiff for an injunction, preliminary or perpetual or to any other and further relief against these defendants.

Wherefore defendants pray to be hence dismissed with the costs against the said plaintiff in this cause sustained and they pray for such other and further relief as to the Court may seem just.

Muncie Gear Works, Inc.,
Bruns & Collins, Inc.,
By Chas. W. Rummler,
Solicitor for Defendants.
7 So. Dearborn St.,
Chicago, Ill.,
Central 3418.

17 SCHEDULE "A".

Patents in Suit.

	Pat. Number	Reference No.
Evinrude	1,786,835	1
Pierce	Re 18,118	2
Igrens	1,802,652	3
Igrens	1,869,749	4
Arndt	1,875,912	5

Prior Art.

Name	Number	Date	Cited against Patent in Suit
Sturges	747,801	Dec. 22, 1903	2
Thorsen	871,459	Nov. 19, 1907	2
Evinrude	1,001,260	Aug. 22, 1911	2
Ducassou	1,034,987	Aug. 6, 1912	2
Miller	1,073,920	Sept. 23, 1913	4
Perkins	1,131,862	Mar. 16, 1915	2, 4
Hardy	1,169,030	Jan. 18, 1916	4
Miller	1,195,146	Aug. 15, 1916	2
Hult	1,228,776	June 5, 1917	2
Cowles	1,234,293	July 24, 1917	1, 4, 5
Moore	1,252,360	Jan. 1, 1918	4
Butler	1,274,678	Aug. 6, 1918	1
Szekely	1,295,234	Feb. 25, 1919	1
Buehner	1,317,480	Sept. 30, 1919	5
Patch	1,357,079	Oct. 26, 1920	4
Applin	1,366,149	Jan. 18, 1921	1
Wahl	1,446,775	Feb. 27, 1923	1
Buehner	1,460,570	July 3, 1923	5
Gunn	1,464,568	Aug. 14, 1923	1
Mould	1,502,479	July 22, 1924	1
Ashbury	1,511,867	Oct. 14, 1924	2, 4
Evinrude	1,524,857	Feb. 3, 1925	1, 2, 4
Mould	1,577,865	Mar. 23, 1926	2
Pierce	1,579,834	Apr. 6, 1926	1, 2, 5
Hillborn	1,634,942	July 5, 1927	2
Grass	1,639,339	Aug. 16, 1927	2
Gray	1,656,629	Jan. 17, 1928	4
Stranahan	1,697,794	Jan. 1, 1929	4
Johnson	1,716,962	June 11, 1929	2
King	1,734,911	Nov. 5, 1929	4

British Patents.

Lanchester	14,792	July 2, 1902	2
Nydeggar	16,121	1913	1
Saunders	179,607	Nov. 1, 1921	2
Roness Engr. Co.	295,865	May 4, 1928	1
Roness Engr. Co.	296,226	May 14, 1928	1, 4

French Patents.

Echard	463,386	Feb. 20, 1914	1, 2, 5

18 German Patents.

Name	Number	Date	Cited against Patent in Suit
Mandl	345,103	Apr. 22, 1920	1

Swiss Patents.

Ziegenspeck	58,818	Dec. 26, 1911	2

Other Publications.

"A Treatise on Hydraulics", pages 317-318 by Mansfield Merriman. Pub. 1896 by John Wiley & Sons, N. Y.	1, 2, 5
"The Speed and Power of Ships" by D. W. Taylor, Vol. I, pp. 124-125, Vol. II, Figs. 3 to 20, Pub. 1910 by John Wiley & Sons, Inc., N. Y., N. Y.	1, 2, 5
"Text-Book of Theoretical Naval Architecture" by Edward L. Atwood, pages 250-256. Pub. Jan. 1919 by Longmans, Green & Co., London, England	1, 2, 5

19 Service and receipt of a copy of the foregoing Answer is hereby acknowledged this 17 day of February, 1939.

Wilkinson, Huxley, Byron & Knight,
Solicitor for Plaintiff.

Filed Jan. 19, 1939.

6 And on, to wit, the 19th day of January, A. D. 1939, there was filed in the Clerk's office of said Court in Case No. 274, a certain Bill of Complaint, in words and figures following, to wit:

7 IN THE UNITED STATES DISTRICT COURT.

Northern District of Illinois,

Eastern Division.

Johnson Brothers Engineering Corporation, a corporation of Indiana, and Outboard, Marine & Manufacturing Company, a corporation of Delaware, *Plaintiffs,* *vs.* Muncie Gear Works, Inc., a corporation of Indiana, and Bruns & Collins, Inc., a corporation of Illinois, *Defendants.*	Civil Docket No. 274.

COMPLAINT SEEKING EQUITABLE RELIEF.

To the Honorable the Judges of the United States District Court for the Northern District of Illinois, Eastern Division:

I. Plaintiffs.

The Plaintiff Johnson Brothers Engineering Corporation, is a corporation duly organized and existing under and by virtue of the laws of the State of Indiana and has its principal office at South Bend, Indiana.

The Plaintiff Outboard, Marine & Manufacturing Company, is a corporation duly organized and existing under and by virtue of the laws of the State of Delaware and has its principal office at Wilmington, Delaware.

II. Defedants.

Defendant Muncie Gear Works, is a corporation duly organized and existing under the laws of the State of Indiana and has its principal office and place of business at Muncie, Indiana.

8 Defendant Bruns & Collins, Inc., is a corporation duly organized and existing under the laws of the State of Illinois, having its principal office and place of business at 2532 South Cottage Grove Avenue at Chicago, Illinois.

III. Jurisdiction.

The jurisdiction of this Court is based on the patent laws of the United States of America. The acts of infringment hereinafter complained of were and are being committed at Muncie, Indiana, Chicago, Illinois, within this District, and elsewhere within the United States.

IV. Patents in Suit.

Plaintiff Johnson Brothers Engineering Corporation, is sole owner, and Plaintiff Outboard, Marine & Manufacturing Company is exclusive licensee, of the following United States Letters Patents:

Johnson 1,716,962 duly and legally issued June 11, 1929
Johnson 1,763,970 duly and legally issued June 17, 1930
Johnson 2,067,533 duly and legally issued Jan. 12, 1937

The rights of the Plaintiffs in said patents as aforesaid have been as above alleged throughout the period of infringement of each such patent hereinafter complained of. Proffert of said patents and the assignments giving Plaintiff Johnson Brothers Engineering Corporation title thereto, is hereby made.

V. Infringement.

Defendants have within the last six years and prior to the filing of this bill of complaint jointly and severally infringed and still are infringing said Letters Patent and each theroef by making, selling and using, in defiance of the rights of the Plaintiffs, outboard motors embodying the respective patented inventions, and will continue to infringe unless enjoined by this court.

9 The claims of the aforesaid patents charged to be infringed are as follows:

Johnson 1,716,962—claims 11, 12, 13 and 14
Johnson 1,763,970—claims 3 and 14
Johnson 2,067,533—claims 1 and 2

VI. Notice.

All devices manufactured under said patents by authority of the owners thereof have borne the required statutory notice of said patents and each of them, and Defendant Muncie Gear Works, Inc. has been notified in writing of said patents No. 1,716,962 and No. 1,763,970 and of its infringement thereof, notwithstanding which Defendants have persisted and continued in their infringement.

VII. Aggravation.

The infringement of Defendant Muncie Gear Works, Inc. has been willful and, for the purpose of unlawfully diverting to itself the demand for outboard motors created by the Plaintiffs, the said Defendant has persistently and habitually copied improvements originated and developed by the Plaintiffs.

VIII. Prayer.

Wherefore Plaintiffs pray for a preliminary and final injunction against further infringement by each Defendant and those in privity with each Defendant as to said patents and each of them, for an accounting for profits and damages to the full amount authorized by law, for an assessment of costs against Defendants, and for such other and further relief as the Court may deem just.

Johnson Brothers Engineering Corporation,
Outboard, Marine & Manufacturing Company,
Plaintiffs,
By S. L. Wheeler,
Counsel for Plaintiffs,
Mariner Tower,
Milwaukee, Wisconsin.

Geo. L. Wilkinson,
Attorney for Plaintiffs,
Address: First National Bank Bdg.,
Chicago, Illinois.

20 And on, to wit, the 17th day of February, A. D. 1939, there was filed in the Clerk's office of said Court in Case No. 274, a certain Answer of Defendants in words and figures following, to wit: Filed Feb. 17, 1939.

21 IN THE UNITED STATES DISTRICT COURT, NORTHERN DISTRICT OF ILLINOIS, EASTERN DIVISION.

Johnson Brothers Engineering Corporation, a corporation of Indiana, and Outboard, Marine & Manufacturing Company, a corporation of Delaware, *Plaintiffs,* *vs.* Muncie Gear Works, Inc., a corporation of Indiana, and Bruns & Collins, Inc., a corporation of Illinois, *Defendants.*	Civil Docket No. 274

ANSWER.

The defendants, Muncie Gear Works, Inc., and Bruns & Collins, Inc., answering the complaint herein say:

1. Answering the allegations of part I of the complaint. The defendants admit that the plaintiff, Johnson Brothers Engineering Corporation is a corporation duly organized and existing under and by virtue of the State of Indiana; but defendants are not advised save by the complaint as to the place or where the principal office of the said plaintiff is located and therefore denies the allegations respecting the same and leaves plaintiff to its proof.

The defendants are not advised save by the complaint as to the corporate organization and existence of the plaintiff, Outboard, Marine and Manufacturing Comapny, or where its principal office is located and therefore deny the allegations respecting the same and leave said plaintiff to its proof.

2. Answering part II of the complaint.

The defendants admit that the defendant, Muncie Gear Works, Inc., is a corporation duly organized and existing

under the laws of the State of Indiana and has its principal office and place of business at Muncie, Indiana.

22 The defendants admit that the defendant, Bruns & Collins, Inc., is a corporation duly organized and existing under the laws of the State of Illinois having its principal office and place of business at 2532 South Cottage Grove Avenue, Chicago, Illinois.

3. Answering part III of the complaint.

Defendants admit that the jurisdiction of this court is based on the Patent Laws of the United States of America, but deny that they have individually or jointly committed any act of infringement or are committing any act or acts of infringement at Muncie, Indiana, or at Chicago, Illinois or elsewhere within this district, or elsewhere within the United States.

4. Answering part IV of the complaint.

Defendants admit that United States Letters Patents No.

1,716,962
1,763,970
2,067,533

were issued on June 11, 1929, June 17, 1930 and January 12, 1937, respectively, but deny that said Letters Patent were duly and legally issued.

Defendants are not advised save by the complaint either that the plaintiff, Johnson Brothers Engineering Corporation is the sole owner or that the plaintiff, Outboard, Marine and Manufacturing Company, is the exclusive licensee of the United States Letters Patents before-mentioned, or that the rights of the plaintiffs in said patents have been as alleged throughout the period of alleged infringement of such patents complained of, and therefore deny these allegations and leave plaintiffs to their proof.

5. Answering part V of the complaint.

Defendants deny each and every allegation thereof.

6. Answering part VI of the complaint.

23 Defendants are not advised save by the complaint whether all or any devices manufactured under the said patents by authority of the owners thereof have borne the required statutory notice of said patents or each or any of them and therefore deny these allegations and leave plaintiffs to their proof.

Defendants admit that the defendant, Muncie Gear Works, Inc., has been notified in writing of said patents No. 1,716,962 and 1,763,970 and that infringement thereof

by said defendant has been alleged, but defendants deny such infringement and deny that notwithstanding such notice defendants have persisted and continued in infringement thereof.

7. Answering part VII of the complaint.

Defendants deny each and every allegation thereof.

Defenses.

8. First defense.

The defendants are informed and believe and therefore aver that each of the patents in suit is invalid and void because prior to the date of the alleged invention thereof by the respective patentees of said patents in suit and more than two years prior to the filing of the applications for said patents, the alleged inventions or improvements described and claimed therein, and all material and substantial parts thereof, had been described in printed publications among which are the patents and publications listed in the annexed schedule "A," which is a part hereof, and others, the dates and patentees, authors and publishers of which the defendants are now unable to supply, but pray leave to add, by amendment to this Answer or otherwise, when they have more fully ascertained the same.

9. Second defense.

The defendants are informed and believe and therefore aver that each of the Letters Patent in suit was and is void and of no effect in law in that the alleged in-
24 ventions or improvements described therein were invented by, or known to, or used by others in the United States, before the alleged inventions of the said patentees of the patents in suit, and for more than two years prior to the respective applications for said patents; among which prior inventors and users and those having prior knowledge are the patentees and their assigns of the several Letters Patents named in the annexed schedule "A," at the places and addresses named in said Letters Patent, and other prior inventors, users and those having prior knowledge the names of whom, and the times and places of such other public uses, being at the present time unknown to defendants, but which, when fully ascertained, defendants pray leave to insert in this Answer by amendments thereto.

10. Third defense.

The defendants are informed and believe and therefore

aver that each of the said Letters Patent in suit is and ever was invalid and void because the alleged improvement purported to be patented thereby do not constitute patentable invention within the meaning of the Patent Laws of the United States, in view of the prior state of the art and in view of what was common knowledge on the part of those skilled in the art, all prior to the time of the alleged inventions by the respective applicants for said patents in suit, but involve merely the ordinary and expected skill of a person versed in the art to which said alleged improvements appertain.

11. Fourth defense.

Defendants are informed and believe and therefore aver that each of the Letters Patent in suit is invalid and void for the reason that the alleged invention thereof purported to be patented thereby are not the same as were disclosed in the application therefor as originally filed, but are substantially different from any invention indicated, described, or suggested in the original applications therefor; that the applications therefor were amended in the specification and claims during the prosecution thereof and the alleged patented subject matter is not supported by oath as required by law; that the said applications were unlawfully enlarged during the prosecution thereof; and that the claims of said Letters Patent are invalid and void for the reason that they include matter not shown or adequately described in the said patents.

12. Fifth defense.

Defendants are informed and believe and therefore aver that while the applications for the said patents in suit were pending in the United States Patent Office, the applicants therefor so limited and confined the claims of said applications under the requirements of the Commissioner of Patents that the plaintiffs herein cannot now seek to obtain construction for such claims sufficiently broad to cover any apparatus or device made, used or sold by these defendants.

13. Sixth defense.

Defendants are informed and believe and therefore aver that the claims of each of the Letters Patent in suit are wholly invalid and void as each of said claims is directed to an old and well-known association of elements, and to old and well-known practices, patentably exhausted long

prior to the inventions or improvements alleged to be covered by said claims, and further that the claims of each of the said patents in suit are wholly invalid and void as the same are for nonpatentable aggregations as distinguished from patentable combinations.

14. Seventh defense.

Defendants aver that they have not at any time infringed the said patents in suit or any of them, and that they are not now threatening and have no intentions or plan in the future to make, use or sell outboard motors
26 or devices of the alleged infringing kind and that they are now manufacturing and selling outboard motors and devices therefor, only of a construction which, as they are informed and believe and therefore aver, do not infringe the said patents in suit or any of them; and the defendants therefore, for these reasons and for the reasons set forth in the preceding paragraphs hereof deny the equity of plaintiffs' complaint and deny that plaintiffs have any right to an accounting for profits, damages or costs to be recovered from these defendants, and they further deny any right of the plaintiffs for an injunction, preliminary or perpetual or any other or further relief against these defendants.

Wherefore defendants pray to be hence dismissed with the costs against the said plaintiffs in this cause sustained and they pray for such other and further relief as to the Court may seem just.

Muncie Gear Works, Inc.
Bruns & Collins, Inc.
By Charles W. Rummler,
Solicitor for Defendants.
7 So. Dearborn St.,
Chicago, Illinois,
Central 3418.

27 SCHEDULE "A".

Patents in Suit.

	Pat. Number	Reference No.
Johnson	1,716,692	1
Johnson	1,763,970	2
Johnson	2,067,533	3

Prior Art.

Name	Number	Date	Cited against Patent in Suit
Thorsen	871,459	Nov. 19, 1907	1
Ducasson	1,034,987	Aug. 6, 1912	2
Barlow, et al.	1,099,684	June 9, 1914	1
Stokeman	1,131,287	March 9, 1915	1
Hult, et. al.	1,146,427	July 13, 1915	3
Smith	1,226,400	May 15, 1917	1, 2
Cowles	1,234,293	July 24, 1917	1
Tripp	1,359,291	Nov. 16, 1920	3
Wahl	1,446,775	Feb. 27, 1923	1
Buehner	1,460,570	July 3, 1923	1
Johnson	1,467,641	Sept. 11, 1923	1
Toennes	1,481,112	Jan. 15, 1924	1
Mould	1,502,479	July 22, 1924	1
Ashbury	1,511,867	Oct. 14, 1924	2, 3
Evinrude	1,524,857	Feb. 3, 1925	2
Johnson	1,559,616	Nov. 3, 1925	1, 2
Johnson	1,567,512	Dec. 29, 1925	1
Johnson	1,574,977	Mar. 2, 1926	1
Dawson	1,576,237	Mar. 9, 1926	1
Pierce	1,579,834	April 6, 1926	1, 2
Rice	1,733,361	Oct. 29, 1929	3
Rebezzana	1,806,584	May 19, 1931	3

British Patents.

Lanchester	14,792	July 2, 1902	1
Saunders	179,607	Nov. 1, 1921	1
Roness Engr Co., et al.	296,226	Nov. 9, 1927	2

German Patents.

Mandl	345,103	Apr. 22, 1920	1
Zeppelin	369,209	Mar. 6, 1920	1

French Patents.

Echard	463,386	Feb. 20, 1914	1, 2

28 Other Publications.

"A Treatise on Hydraulics," pages 317-318 by Mansfield Merriman. Pub. 1896 by John Wiley & Sons, N. Y. 2

"The Speed and Power of Ships" by D. W. Taylor, Vol. I, P. 124-125, Vol. II, Figs. 3 to 20, Pub. 1910 by John Wiley & Sons Inc., N. Y., N. Y. 2

"Text-Book of Theoretical Naval Architecture" by Edward L. Atwood, pages 250-256, Pub. Jan. 1919 by Longmans, Green & Co., London, England 2

Power Boating—August, 1922—page 35 "A Pumpless Outboard Engine" by C. B. Warner 1

"Design of Aeroplanes" by Arthur W. Judge, page 8, lines 5-12, Published 1917 by J. Selwyn & Co. 1

Graybar Electric Co., Catalog #100, Published 1929 by Graybar Electric Co., Pages 402, 414, 417 and 650 3

29 Service and receipt of a copy of the foregoing Answer is hereby acknowledged this 17 day of February, 1939.

W., H., B. & K.,
Solicitors for Plaintiffs.

30 And on, to wit, the 25th day of January, A. D. 1940, there was filed in the Clerk's office of said Court a certain Stipulation in words and figures following, to wit:

Filed Jan. 25, 1940.

31 IN THE UNITED STATES DISTRICT COURT,

Northern District of Illinois,

Eastern Division.

Outboard, Marine & Manufacturing Company, a corporation of Delaware,
Plaintiff,
vs.
Muncie Gear Works, Inc., a corporation of Indiana,
and
Bruns & Collins, Inc., a corporation of Illinois,
Defendants.

Civil Docket No. 273.

Johnson Brothers Engineering Corporation, a corporation of Indiana,
and
Outboard, Marine & Manufacturing Company, a corporation of Delaware,
Plaintiffs,
vs.
Muncie Gear Works, Inc., a corporation of Indiana,
and
Bruns & Collins, Inc., a corporation of Illinois,
Defendants.

Civil Docket No. 274.

STIPULATION.

It is stipulated by the parties to the Causes above identified:

1. With the consent and approval of the Trial Court these Causes shall be consolidated and a single transcript of the record of proceedings had shall constitute the record in both cases. The testimony and exhibits offered in the course of said proceedings shall be entitled in and constitute the testimony and exhibits in both of the above Causes.

32 2. The parties are corporations organized and existing and having offices as alleged in paragraphs 1

and 3 of the Complaint and this Court has jurisdiction of the above entitled actions.

3. Plaintiff, Outboard, Marine & Manufacturing Company, is the owner of United States Letters Patents Nos. 1,786,835 and 1,869,749 and 1,875,912 and Re. 18,118 and all rights of action for recovery for any infringement of said patents which may be shown to have occurred during the period for which Defendants have been manufacturing, selling and using the devices accused as infringements in Cause No. 273.

4. Throughout the period for which Defendants have been manufacturing, selling and using the devices accused as infringements of United States Letters Patents Nos. 1,716,962 and 1,763,970 in Cause No. 274, said patents have been owned by Plaintiff, Johnson Brothers Engineering Corporation and licensed to Plaintiff, Outboard, Marine & Manufacturing Company, and said Plaintiffs are possessed of all rights of action and recovery for any infringement which may be shown to have occurred during said period.

5. The complaint as to Irgens patent 1,802,652 named in the Bill of Complaint in Cause No. 273 may be dismissed on motion of the Plaintiff.

6. The complaint as to Johnson patent 2,067,533 named in the Bill of Complaint in Cause No. 274 may be dismissed on motion of the Plaintiffs.

7. Defendants have issued literature exemplified by Exhibits 1, 2, 3 and 4 hereto annexed, for the years 1936, 1937, 1938 and 1939 respectively, and the outboard
33 motors illustrated in said literature were included among the products manufactured, sold and used by the Defendants during such years.

8. Exhibits hereto annexed and marked 5, 6, 7, 8 and 9 correctly portray the mechanical construction of Defendants' 9 and 16 h. p. models of outboard motor for the year 1939 and are typical of the constructions involved in this litigation. There have not been changes in any respect material to this controversy in the 9 h. p. model at least since January 1938 and in the 16 h. p. model at least since January 1936.

9. Uncertified printed or photostatic copies of the specifications and drawings of United States and foreign patents may be offered and received in evidence subject to correction if error appear, with the same force and effect as the originals of said patents or duly certified copies

thereof. Subject to correction, upon comparison with the originals or certified copies of said patents or their respective application files, the dates and facts as to the filing of their respective applications, the grant or publication of the respective patents, and the names and facts of assignment as to the respective inventors, patentees and assignees shall be prima facie accepted as officially printed on said patents or copies.

The authenticity and dates of public use of the "other publications" cited at the end of Schedule A in Defendants' answer are accepted as prima facie correct subject to correction if error appears.

Geo. L. Wilkinson,
S. L. Wheeler,
Attorneys for Plaintiffs.
Chas W. Rummler,
Attorney for Defendants.

December 28, 1939.

(Exhibits 1, 2, 3 and 4 sent up as physical Exhibits.)

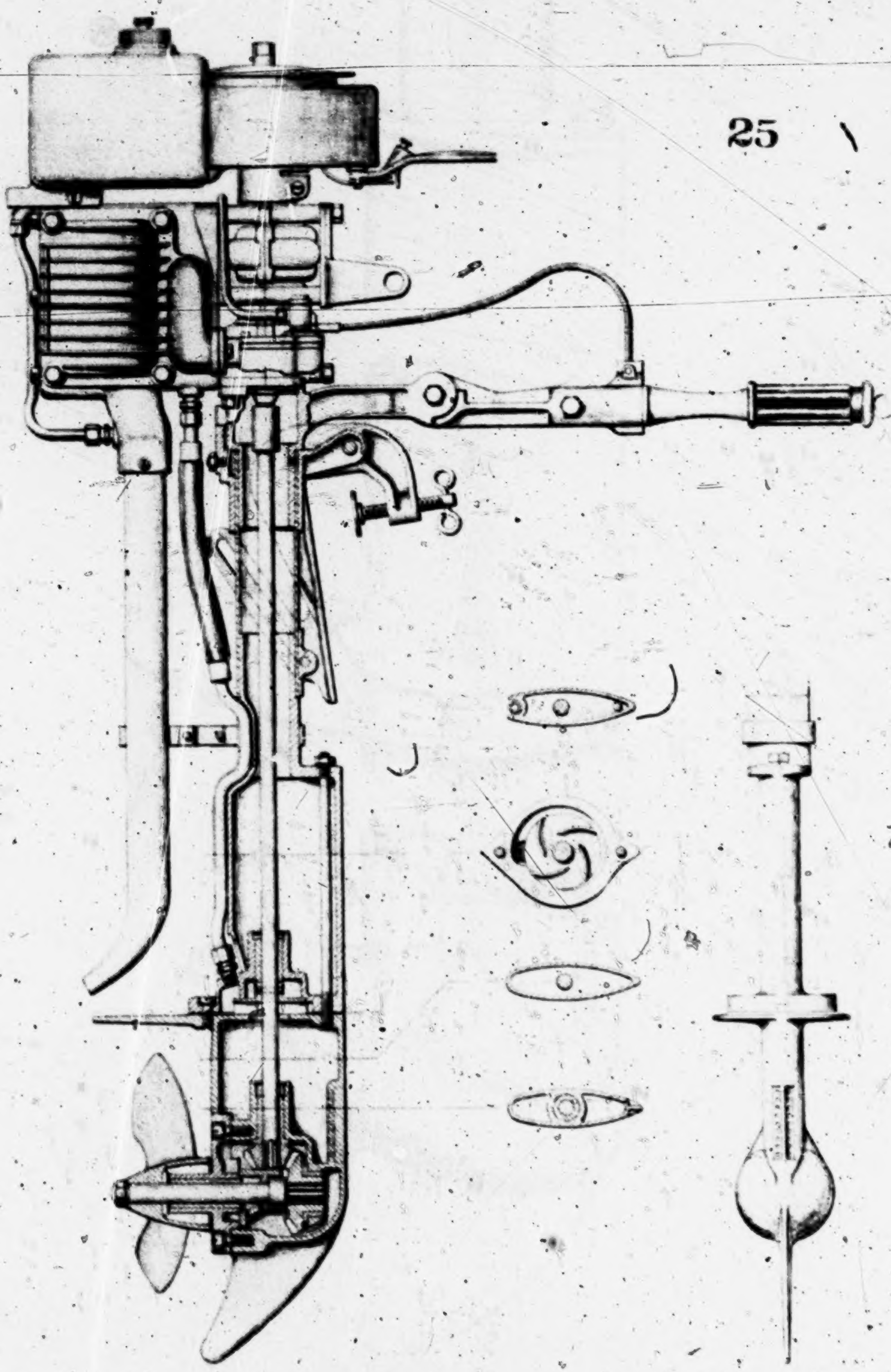


Exhibit 5
Muncie Gear Works, Inc.
9 HP Outboard Motor

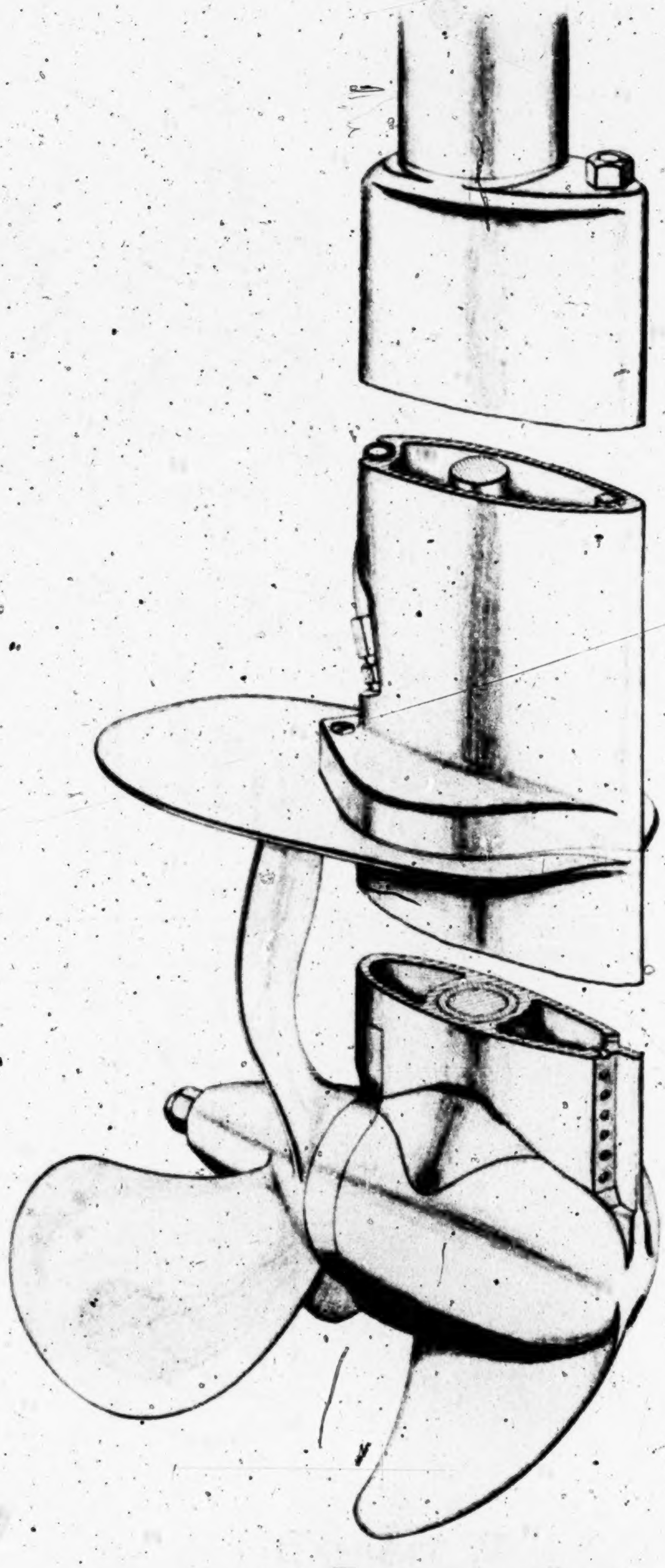


Exhibit 6
Muncie Gear Works, Inc.
9 HP Outboard Motor
Lower Unit

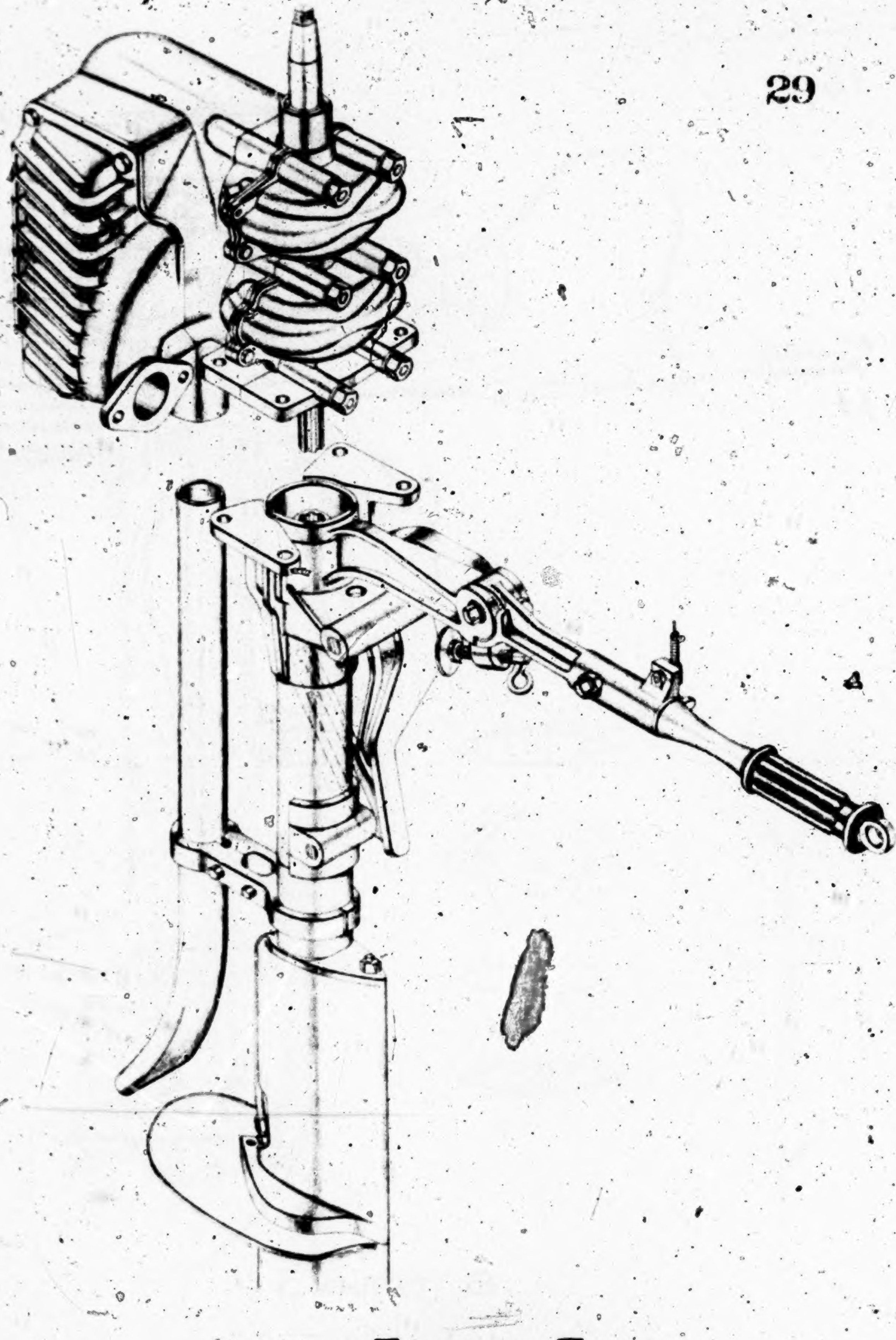


EXHIBIT 7
MUNCIE GEAR WORKS, INC.
9 HP OUTBOARD MOTOR
ENGINE MOUNTING

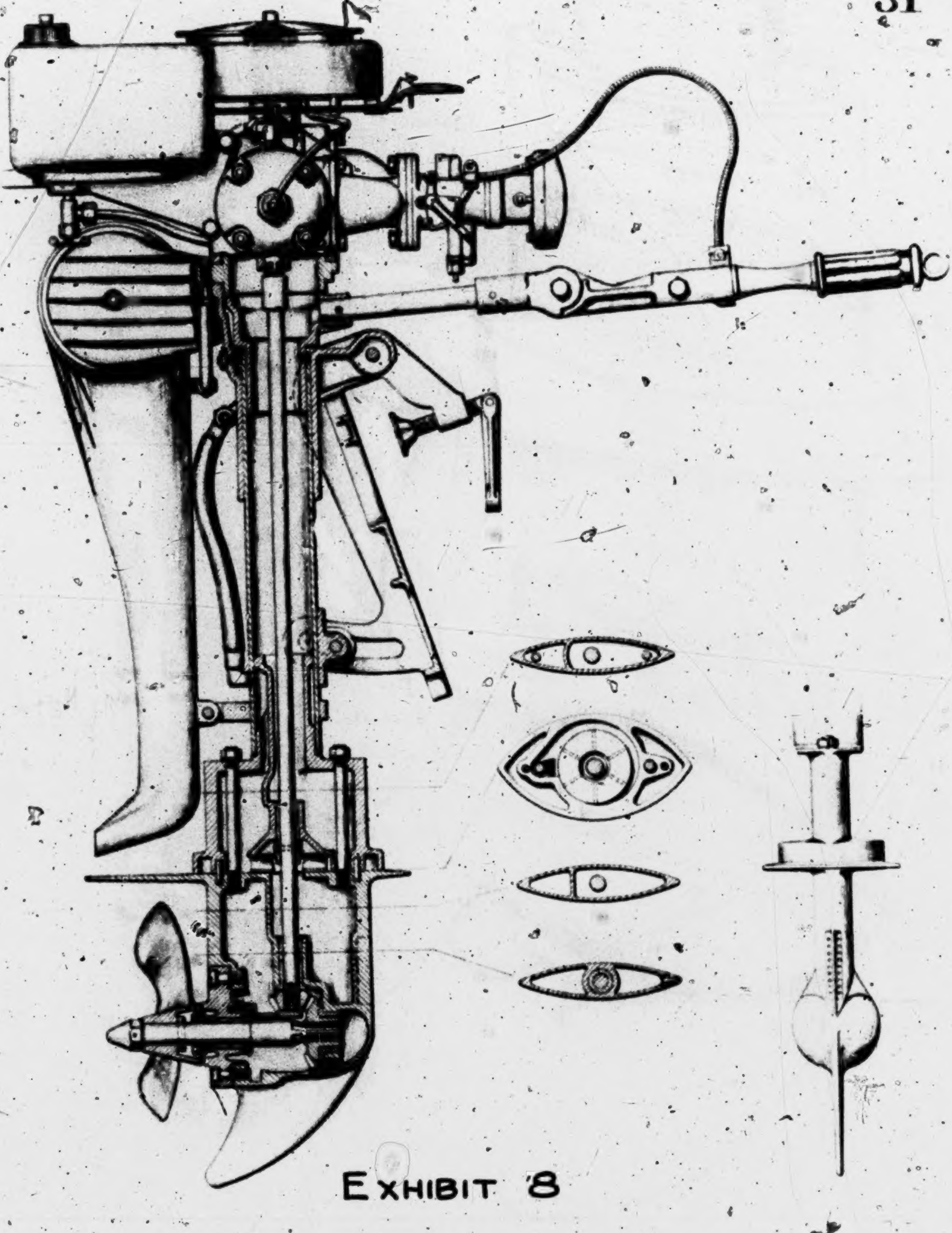


Exhibit 8

Muncie Gear Works Inc.
16 HP Outboard Motor

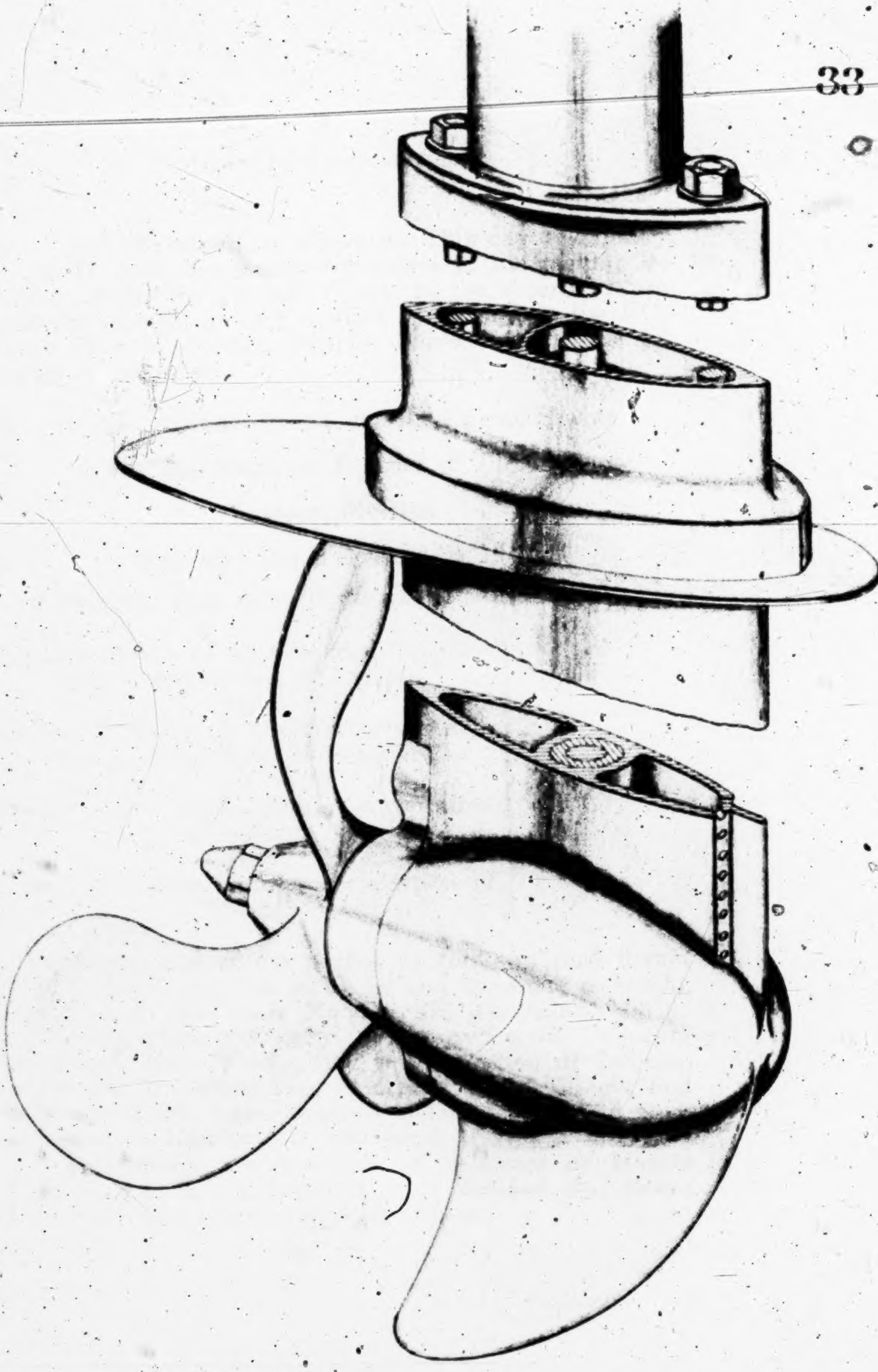


EXHIBIT 9

MUNCIE GEAR WORKS, INC.
16 HP. OUTBOARD MOTOR
LOWER UNIT

39 And afterwards, to wit, on the 25th day of January, A. D. 1940, being one of the days of the regular December, 1939 term of said Court, in the record of proceedings thereof, in said entitled cause, before the Honorable John P. Barnes, District Judge, appears the following entry, to wit: Entered Jan. 25. 1940.

40 In the District Court of the United States

For the Northern District of Illinois,

Eastern Division.

Thursday, January 25, A. D. 1940.

Present: Hon. John P. Barnes, District Judge.

Johnson Brothers Engineering Corporation, a corporation of Indiana and Outboard, Marine & Manufacturing Company, a corporation of Delaware, *vs.* Muncie Gear Works, Inc., a corporation of Indiana and Bruns & Collins, Inc., a corporation of Illinois.	Civil Action No. 274.

On Stipulation of the parties to this suit filed herein It Is Ordered that this cause be and the same is hereby consolidated with cause Number 273, Outboard, Marine & Manufacturing Company, a corporation of Delaware *vs.* Muncie Gear Works, Inc., a corporation of Indiana, and Bruns & Collins, Inc., a corporation of Illinois, and that consolidated cause proceed under the title and number of cause Number 273, Outboard, Marine & Manufacturing Company, a corporation of Delaware *vs.* Muncie Gear Works, Inc., a corporation of Indiana and Bruns & Collins, Inc., a corporation of Illinois.

41 And on, to wit, the 18th day of April, A. D., 1940, there was filed in the Clerk's office of said Court a certain Transcript of Testimony, portions of which are in words and figures following, to wit:

42 IN THE DISTRICT COURT OF THE UNITED STATES.

For the Northern District of Illinois,

Eastern Division.

Outboard, Marine & Manufacturing Company, a corporation of Delaware, *Plaintiff,* *vs.* Muncie Gear Works, Inc., a corporation of Indiana, and Bruns & Collins, Inc., a corporation of Illinois, *Defendants.*	Civil Docket. No. 273.
Johnson Brothers Engineering Corporation, a corporation of Indiana, and Outboard Marine & Manufacturing Company, a corporation of Delaware, *Plaintiffs,* *vs.* Muncie Gear Works, Inc., and Bruns & Collins, Inc., *Defendants.*	Civil Docket. No. 274.

Proceedings had and testimony taken before the Honorable John P. Barnes, one of the judges of said court, in his court room in the United States Court House, at Chicago, Illinois, commencing on Thursday, January 25, 1940, at 4:15 o'clock p.m.

Present:

S. L. Wheeler, Esquire, and George L. Wilkinson, Esquire, representing the plaintiffs;

Charles W. Rummler, Esquire, representing the defendants.

Whereupon the following proceedings were had:

43 Mr. Wheeler: I will offer in evidence as PLAINTIFF'S EXHIBIT 10, a copy of the specification and drawing of Johnson patent No. 1,716,962, of June 11, 1929.

(The exhibit was so marked.)

As PLAINTIFF'S EXHIBIT 11, a copy of Johnson patent No. 1,763,970, dated June 17, 1930.

(The exhibit was so marked.)

As PLAINTIFF'S EXHIBIT 12, a copy of the Pierce Reissue patent No. 18,118, of July 7, 1931.

(The exhibit was so marked.)

As PLAINTIFF'S EXHIBIT 13, a copy of Evinrude patent No. 1,786,835, of December 30, 1930.

(The exhibit was so marked.)

As PLAINTIFF'S EXHIBIT 14, a copy of Irgen's patent No. 1,869,749, of August 2, 1932.

(The exhibit was so marked.)

As PLAINTIFF'S EXHIBIT 15, a copy of Arndt patent No. 1,875,912, of September 6, 1932.

(The exhibit was so marked.)

44 As PLAINTIFF'S EXHIBIT 16, a copy of Johnson patent No. 2,067,533, of June 12, 1937.

(The exhibit was so marked.)

On each of these copies I have placed an asterisk in front of the claims which have been charged by the bill of complaint to be infringed.

The Court: Do you want that stipulation filed?

Mr. Wheeler: I would like to have that stipulation filed, please, and I offer the stipulation and the exhibits thereto attached, Exhibits 1 to 4, inclusive. The pieces of literature stiplated to have been issued by the defendant, Exhibits 5 to 9 inclusive, are drawings which are stipulated to represent the accused constructions. I have handed your Honor a separate set of them.

The Court: It may be received.

45 Mr. Wheeler: I will call as my first witness Finn T. Irgens.

First, I shall offer as PLAINTIFF'S EXHIBIT 17 this specimen, this 9-horse power specimen of the Neptune Twin, defendant's outboard motor product.

(The exhibit was so marked.)

As PLAINTIFF'S EXHIBIT 18 I offer this larger specimen known as the Neptune Master of defendant's outboard motor product.

(The exhibit was so marked.)

FINN T. IRGENS, called as a witness on behalf of the plaintiff, having been first duly sworn, testified, as follows:

Direct Examination by Mr. Wheeler.

Q. Please state your full name, age, residence and occupation?

A. Finn T. Irgens; born April 4, 1897; address, 2424 North 98th Street, Wauwatosa, Wisconsin, and I am employed by the Outboard, Marine & Manufacturing Company as chief engineer and production manager for the Evinrude Division at Milwaukee, Wisconsin.

46 Q. Do you also serve as chief engineer for the Johnson Division of the plaintiff company?

A. No, I do not.

Q. Please state what your experience in outboard motors has been.

A. In 1921 I worked for the Johnson Motor Company in South Bend, Indiana, and at that time I helped Mr. Louis Johnson to design the first outboard motor.

Late in 1921 I went to Purdue University and graduated from there in 1923 in mechanical engineering. At that time I went back to the Johnson Motor Company as assistant chief engineer, working for Mr. Louis Johnson.

In 1925 I went to the Lockwood Motor Company in Jackson, Michigan, Lockwood-Ash Motor Company, and worked as chief engineer for the Lockwood Ash Motor Company until they merged with the Evinrude and Elto Motor Company. They merged in 1929. At that time I went to Milwaukee, Wisconsin, and served as chief engineer for the new corporation until 1937, I believe it was, when that company merged with the Johnson Motor Company, and formed the Outboard Marine & Manufacturing Company, and that is the company I am employed by at present.

47 Q. Had you had previous engineering training before going to Purdue University?

A. Yes. I had worked on aviation engines for the Dusenberg Motor Company, also on marine engines at the same time, and worked as chief draftsman for the Willys Corporation at Elizabeth, New Jersey, designing automobiles.

Q. What, if any, engineering school had you attended previously?

A. I had some mechanical education in Norway.

Q. Are you familiar with the structures of the patents here in suit?

A. Yes, I am.

Q. I will ask you to refer to the structure of the lower unit shown in Johnson patent No. 1,716,962, Plaintiff's Exhibit 10, and describe the structure and its functions to the Court.

A. The structure of the lower unit of that drawing is numbered 17. That performs the function of a housing enclosing shafting and gearing to drive the propeller from the engine.

The housing shows an integral anti-cavitation plate which overlies the propeller path. The housing is shown with a barrel-like portion which encloses a propeller
48 shaft and it shows smooth walls as the housing extends upwardly.

The anti-cavitation plate is mounted aproximately halfway between the top and the bottom of the vertical extension. The housing also encloses water pipes or water passages.

I believe that covers it.

Q. Where do these water passages lead and what purpose do they serve?

A. The water passages lead from below normal water level up through the engine structure to the engine cylinders and then back down to below water level again.

Q. In this particular structure, which is the inlet, what causes the water to move in the inlet?

A. The water inlet is numbered 18 and that is mounted behind the propeller and the propeller pushes water into the inlet and from there on up to the engine.

Q. How does the propeller affect, if it does affect the movement of water with respect to the discharge passages 13?

A. Well, the propeller causes a current of water to pass the gear housing and has a suction created by the orifice 13.

Q. What causes that suction?

49 A. That is the vacuum created behind the propeller and also the asperating effect of the water rushing past the housing.

Q. You mean behind the propeller in the direction of movement?

A. No, it would be in front of the propeller as far as the direction of movement is concerned.

Q. What happens to the water to cause that vacuum? Will you explain that?

A. The propeller drives the water and creates a slip-stream. When the propeller goes through the water there is a pressure created on the driving side of the propeller and there is a vacuum created on the suction side of the propeller and the suction side of the propeller is next to the orifice 13.

Q. Does that vacuum have any effect on the propulsion of the device?

A. Yes, the vacuum creates quite a high propulsion effort.

Q. How is that vacuum relieved, if it is relieved?

A. The vacuum is relieved by water in front of the housing rushing toward the propeller.

Q. What is the purpose of the plate 20?

A. The plate 20 is known as an anti-cavitation
50 plate and the purpose of that is to prevent air from being sucked down into the propeller slip-stream.

Q. What is the effect of air being sucked into the propeller slip-stream?

A. It hurts the efficiency of the propeller.

Q. In what way?

A. It causes cavitation and the propeller loses its grip on the water.

Q. With what result?

A. That the motor will speed up and the propulsion effort of the motor is reduced and results in great inefficiency of the motor as a driving unit.

Q. In the absence of such a plate, may, under certain circumstances, that speeding up of the engine reach a degree that is dangerous?

A. Yes, if it cavitates too violently the motor can run away and actually break up.

Q. In what type of motors are these plates used?

A. They are used on relatively large and fast motors.

Q. Why?

A. Because as the power is increased the tendency toward cavitation is also increased.

Q. How does the plate operate in such a way as to prevent or minimize cavitation?

51 A. The plate has to be submerged and there should be a sheet of water overlying the plate and the

plate thereby effectively seals any tendency for air being sucked down from the surface of the water, down into the propeller stream.

Q. Now does the form of the housing 17 have any relation to the problem of cavitation?

A. Yes, the housing 17 must be shaped in such a way that the water will move smoothly around the housing without having any eddy currents created.

Q. What effect do eddy currents have on the problem of cavitation?

A. If eddy currents are created then cavitation is very much more apt to result.

Q. How?

A. When an eddy current is created it forms a vortex or hollow through which air can be sucked down into the propeller stream.

Q. Now with reference to that portion of the casing 17 which is above the plate 20, please state whether that has any effect, particularly on the question of cavitation?

A. Yes, it has, because the water, after being split by the housing, must also close behind the housing
52 in order to eliminate any possibility of creating a hollow behind the housing through which air might be sucked.

Q. And if the water fails to close properly behind the housing, would that have any bearing on the ability of the anti-cavitation plate to resist these eddy currents?

A. Yes, it would.

Q. In what way?

A. If the water does not close behind the housing there would be a void, there would be a pocket through which air could reach the propeller very much easier.

Q. What, if anything, is the preferred relationship between the propeller and the surface of the water?

A. For high propulsion efficiency the propeller should be placed as close to the surface as possible.

Q. When you say as close as possible, what do you have in mind?

A. If the propeller is too close to the surface it is bound to cavitate easier.

Q. Does the existence of this structure containing the anti-cavitation plate 20 and the smooth walled housing 17 have any bearing on the distance at which the pro-

peller can be located with reference to the surface of the water?

A. Well, by using an anti-cavitation plate it is
53 possible to move the propeller closer to the surface than it would be otherwise.

Q. What, if any, advantage is there in locating the water passages on the interior of such a housing? Would they work just as well on the outside?

A. As water passages they would work just as well on the outside, but for stream line effect they would not. They would obstruct or hurt the stream line functioning of the housing.

Q. To what extent is this structure used in the industry at the present time?

A. At the present time it is universally used on all high speed relatively large outboard motors.

Q. You are referring now to the smooth walled housing?

A. The smooth walled housing, as well as the anti-cavitation plate combination.

Q. How about the internal water passages exactly as shown in this device?

A. Well, not exactly as shown. There are different methods of bringing the water up to the motor. All the big motors have internal water passages within the stream line contours.

Q. Do air-cooled motors have such internal passages?

A. No, they do not. But no large air-cooled motors
54 are built at present.

Q. Do both divisions of the plaintiff use constructions of that sort on their large motors?

A. Yes, they do, on all their large motors.

Q. To what extent does the Johnson Division use that construction of a smooth walled housing, internal water passages and an anti-cavitation plate midway of the height?

A. Well, the Johnson Division uses that construction practically entirely throughout all their motors, small and large.

Q. To what extent does the Evinrude Division use it?

A. The Evinrude Division is only using that construction in their bigger motors, and that probably means about twenty per cent of their total number of motors produced.

Q. Why is that?

A. Every time Evinrude uses that construction it costs the company money.

Q. In other words, the Evinrude Division pays a royalty on that construction?

A. That is right. The Evinrude Division pays a royalty on every lower unit of that type which they manufacture.

55 Q. Do you know whether any other company has been licensed to use that construction?

A. Yes, the Champion Motor Company, of Minneapolis, is licensed.

Q. Do you know of any other company, other than the present defendant, who is using that construction without their being licensed or negotiating for a license?

A. No, I do not.

Q. In your opinion, would it be possible to make a high speed, high powered engine, water cooled, that would not have the construction of the patent, so far as the smooth walled housing, the anti-cavitation plate and the internal water passages are concerned?

A. At the present time I do not.

Q. How long has it been true that all of the larger sizes of outboard motors have been equipped with smooth walled lower unit housings, anti-cavitation plates intermediate the top and bottom thereof, and internal water passages?

A. They became popular about 1926, and from then on practically all of them have been made that way.

Q. Prior to 1926 were large marine engines known?

A. Yes.

Q. Were outboard motor boats being raced prior
56 to that time?

A. Yes.

Q. Were speedy hulls known prior to that time?

A. Yes.

Q. Had anybody put what you now know as an outboard high powered engine in an outboard motor prior to that time?

A. Yes.

Q. How high powered?

A. I have seen one patent in particular that shows quite a good sized outboard motor pictured on it. What the exact power was, of course, it is not possible to determine.

Q. I mean in outboard motor practice, to your knowledge, had anyone prior to 1926 used a high powered engine practically in an outboard motor?

A. No.

Q. What do you mean by high powered engine such as you say would require the use of that type of lower unit?

A. That would be an engine that would be able to drive a boat at a high speed.

Q. And about what horse power would that be, assuming that you used a hull designed for high speed?

57 A. We can obtain high speed with motors as low as 5-horse power. That is what we would term planing, that is, when the hull runs fast enough to actually ride on top of the water.

Q. What reference has the planing speed, if any, to this particular construction that you have been describing?

A. When you are running at such high speed it is absolutely essential to have a stream line construction and have means to prevent cavitation.

Q. If you do not have means for preventing cavitation on a high speed planing boat, what happens?

A. It will cavitate and be absolutely unsafe.

Q. Do you regard the smooth walled housing and the anti-cavitation plate as being both necessary to prevent cavitation in such a boat?

A. Yes.

Q. Will you please refer to this outboard motor, Plaintiff's Exhibit 18, and show the Court whether you find therein any such construction as that to which you have testified?

A. We have a stream lined gear housing and have a primer portion enclosing the propeller shaft, and a gearing. We have an integral anti-cavitation plate, and
58 we have internal water passages. The water intake is in front of the housing and the water rises through the housing to a pump, and from that pump it goes up through the housing and finally reaches the engine.

Q. How is that anti-cavitation plate fastened to that housing?

A. It is cast on to the lower portion of it.

Q. Will you refer to Plaintiff's Exhibit 17, defendant's smaller motor, and state whether that employs any construction capable of avoiding cavitation at planing speeds?

A. This motor employs the stream lined gear housing

and also integral anti-cavitation plate, which will both tend to eliminate cavitation.

Q. Does this gear housing extend in its smooth walled form above the anti-cavitation plate in this device?

A. Yes.

Q. Does this housing have an internal vertically extending water passage?

A. Yes.

Mr. Wheeler: For the purpose of the record I wish to note the fact that it is conceded by the defense that the two outboard motors in evidence as Plaintiff's Exhibits 17 and 18 were both made by the defendant Muncie
59 Gear Company within six years next preceding the commencement of the suit.

Q. Are you familiar with the structure of the L. J. Johnson patent No. 1,763,970?

A. Yes, I am.

Q. Will you please describe to the Court why that structure employs the peculiar shape of lower unit illustrated particularly in Figures 3, 4, 5 and 6?

A. That drawing shows a stream lined gear housing with an integral anti-cavitation plate. Above the anti-cavitation plate the stream line is sharp at the upward edge, as well as at the trailing edge. Below the anti-cavitation plate the forward contour is rounded, which forms a blunt nose, and the trailing edge is sharp.

Q. What is the purpose of rounding the cross-section of the forward edge of the stream lined lower unit below the anti-cavitation plate?

A. It increases the efficiency of the housing by reducing the surface of the housing and reducing the surface friction.

Q. If the housing had below the anti-cavitation plate the same section that it has above the anti-cavitation plate there would be greater friction?
60 A. There would be greater friction, due to a greater surface.

Q. Then why does this housing employ a sharp and more extended cross-section above the anti-cavitation plate?

A. The section above the anti-cavitation plate lies at or close to the surface of the water and in this position it is necessary to make it sharp so that the water won't be thrown away from the housing, because the housing would set up quite a wave formation.

Q. What, if anything, would be the disadvantage of such a wave formation?

A. The water might be thrown away from the housing fast enough or far enough so that the water would not close around the housing, and thereby cavitation would result.

Q. Might such cavitation result despite the presence of the plate 62?

The Witness: Will you repeat that, please?

Q. Might such cavitation result under those circumstances despite the presence of the plate 62?

A. Oh, yes, if the plate happens to be too small or if the stream line is not properly proportioned relative to the speed, then we must still get cavitation.

61 Q. Is there any advantage in making the plate as small as possible?

A. Yes, the smaller the better, because surface friction is reduced.

Q. Does surface friction represent any considerable disability, does it impair to any considerable extent the speed that it is possible to obtain with one of these devices?

A. Yes, materially.

Q. Will you please indicate to the Court approximately where the water line would ordinarily be in the operation of a device of this kind in accordance with the intention of its designers?

A. The water line would be somewhere around this section (indicating).

Q. You are pointing approximately to the point where 6-6 is taken on Figure 3?

A. Yes. Figure 4—Oh! Figure 3; yes.

Q. Do you find in either of the defendant's products as exemplified by Plaintiff's Exhibits 17 and 18, any construction in which there is such a stream lined lower unit, with the anti-cavitation plate below water level on it and a sharp stream lined section above the plate with a blunted stream lined section below the plate?

62 Will you please point out the parts to which you refer in your answer?

A. If we consider this gear housing of a 16-horse power motor, that has a sharp forward edge and a sharp trailing edge above the anti-cavitation plate and below the anti-cavitation plate it has a sharp trailing edge and

a part of the forward edge is blunt. due to the water intake.

Q. Would the bluntness to which you refer give the effect that you have described as being desirable in such a location:

A. Yes, it would.

Q. Does the presence in that device at the water intake of the vertical rib prevent that from being a blunt forward edge within the meaning of your testimony?

A. No.

Q. Does it materially affect the way in which the water will flow around that section?

A. No, I don't think it will affect it at all.

Q. What, if anything, do you understand to be the function of that rib?

A. The rib acts as a protection for the water intake, to prevent weeds and leaves from clogging the water intake.

63 Q. So far as the flow around the housing is concerned, the device would function substantially the same whether that rib is present or absent; is that correct?

A. Yes.

Q. Are you familiar with the lower unit shown in Pierce Reissue 18,118, Plaintiff's Exhibit 12?

A. Yes, I am.

Q. Will you please describe that, briefly?

A. The drawing shows a stream lined gear housing with a parallel portion enclosing the propeller shaft and the gearing in a stream lined vertical section enclosing water passages.

Q. Do you understand the function of that vertical section?

A. The vertical section acts as a stream line around the water passages and the driveshaft, as well as to act as a rudder.

Q. What was the manner in which outboard motors were generally steered, say in 1922, when the Johnson Motor Company entered the field?

A. The Johnson motor was arranged to pivot around the vertical drive shaft for steering purposes.

Q. Did the motor in thus pivoting for steering purposes include any rudder as a part of the housing?

64 A. The Johnson motor did not.

Q How then was the steering effected with such a motor?

A. The steering was effected entirely at the slip-stream, the direction of the slip-stream.

Q. Will you explain how the direction of the slip-stream would steer the boat?

A. A slip-stream is pushed straight backwards from the propeller and as the gear housing is turned around the vertical axis the slip-stream is moved sidewise and pushes the boat in a different direction.

Q. Was the Evinrude Motor Company a competitor of Johnson at that time?

A. Yes.

Q. Were you familiar with those outboard motors?

A. Yes.

Q. How were they steered?

A. The Evinrude motors also steered with a propeller slip-stream.

Q. Were you familiar with the Elto outboard motor at that time?

A. Yes.

Q. How did it steer?

A. The Elto motor had a stationary gear hous-
65 ing and was equipped with a rudder.

Q. Where did that rudder project with reference to the propeller?

A. The rudder projected behind the propeller.

Q: Was there any other steering arrangement in use at that time, to your knowledge?

A. No.

Q. So that all the outboard motors with which you were familiar in 1922 either steered by turning the propeller to one side or the other and using the slip-stream thrust, or else by use of a rudder behind the propeller; is that correct?

A. That is correct.

Q. To what extent, in just rough proportions, was the idea of turning the lower unit for steering employed in comparison with the number of motors that used rudder steering?

A. There were many more motors produced using the propeller slip-stream for steering than those using a rudder.

Q. Would you please indicate to the Court where you understand the water line to be, approximately, in the device shown in the Pierce patent?

A. Do you want me to point it out?

66 Q. Describe it, if possible, so we can get it in the record.

A. The water line should be somewhere between the numerals 16 and 18.

Q. You mean at the approximate level of the lead lines on which those numerals appear in Figure 1?

A. Yes.

Q. What leads you to make that answer?

A. It has stream lined gear housing and for efficient propulsion the propeller should be as close to the surface as possible, and judging from general practice that would be a good level to run the propeller at.

Q. Do you find that in either or both of the defendant's structures as exemplified in Plaintiff's Exhibits 17 and 18 there is any structure in any way corresponding to that which you have just described?

A. Yes. Both the gear housings used on those motors are stream lined to a point above the water level.

Q. Are they in each instance used for steering?

A. They are used for steering.

Q. What is the fact as to the possibility of steering the types of motors made by Johnson and Evinrude back in 1922 after power had been cut off from the propeller?

A. When you cut the power off in the propeller
67 by stopping the motor and the boat still having headway, there was no steering effort from any part of the housing.

Q. You mean you could not control the boat after the propeller stopped?

A. You could not control the boat after the propeller stopped.

Q. What is the fact as to whether it is possible to control the direction of a boat equipped with one of defendant's motors, after the motor has stopped?

A. Well, the stream lined gear housing has quite a width fore and aft, acting as a rudder surface, and you do have some control of the boat after the power is shut off.

Q. You can steer with your housing after the power is shut off?

A. You can steer with your housing after the power is shut off.

Q. Will you please refer to the drawing of the Arndt patent No. 1,875,912, Plaintiff's Exhibit 15, and show the Court what arrangement is made with reference to the intake of water?

A. The intake of water is located in the front of the housing and numbered 33; that is in the leading
68 edge of the housing.

Q. What is the form of the housing?

A. The housing is stream-lined.

The Court: What was that question?

Mr. Wheeler: What is the form of that housing.

The Court: No, the preceding question.

Mr. Wheeler: Read the question, please.

(The record was read as follows:

"Q. Will you please refer to the drawing of the Arndt patent No. 1,875,912, Plaintiff's Exhibit 15, and show the Court what arrangement is made with reference to the intake of water?

"A. The intake of water is located in the front of the housing and numbered 33; that is in the leading edge of the housing.

"Q. What is the form of the housing?

"A. The housing is stream lined."

The Court: Very well. Proceed.

Mr. Wheeler: Q. Will you please describe the shape and disposition of the water intake as shown, particularly Figures 1 and 2 of this patent?

A. In Figure 1 the water intake is shown at No. 33, which is in the leading edge of the housing, and in Figure 2 it is also shown and numbered 33, in the front edge of the housing, and is relatively narrow and extends upward for some distance.

69 Q. Is that water inlet subdivided and if so, for what purpose?

A. The water intake is subdivided by wires to form a screen and that is to prevent foreign matter from going up into the cooling system.

Q. What is the reason for using a vertically elongated water inlet and for locating it at this particular point?

A. The reason for using a vertically elongated inlet is to keep it relative narrow so that it won't interfere with the stream lined shape of the housing, and also

to provide enough space for enough water to enter the motor.

Q. What would happen if that were located elsewhere and perhaps in a different form to have an equal water gathering capacity?

A. Well, if it was extended around in a horizontal direction then it would be difficult to get the same water pressure at all points of the intake.

Q. What is the condition of pressure that exists in such a housing?

A. As the intake is shown in the drawing, we have the same water pressure throughout the whole area of the intake.

70 Q. When any stream lined body moves through the water what are the conditions of pressure that exist around its surface?

A. There is a high pressure at the leading edge. It is very possible, however, to get low pressures along the side walls.

Q. By low, do you mean atmospheric or sub-atmospheric or above atmospheric?

A. The pressure can be below atmospheric if the housing is made in such a way.

Q. Please describe in detail, so the Court will understand exactly, how these pressures occur and what controls their occurrence?

A. Figure 3 shows a stream lined section of that particular housing and that is moved in the direction toward the right and as the water impinges on the forward edge of the housing there is bound to be a high pressure. Then the housing has to split your water in order to go through it and if the housing is running fast enough the water can be diverted sidewise fast enough so as to create a low pressure area along the sides of the housing.

Q. What would happen if the water inlet were so located as to extend into such a low pressure area?

71 A. We might have suction at that portion of the intake.

Q. What should you have at the intake?

A. We should have pressure. That is the purpose of the intake.

Q. Why do you want pressure at the intake?

A. In order to insure proper water circulation in the cooling system.

Q. Assuming that you have a pressure at the intake, does it help or hinder the circulation of water through the cooling system?

A. It helps the circulation.

Q. Do you find in either or both of defendant's accused constructions, as exemplified by Plaintiff's Exhibits 17 and 18, any water intake which is vertically elongated and located at the zone of pressure in a stream lined housing?

A. Both those motors show that type of an intake.

Q. Will you please describe that intake in detail in order to explain your answer?

A. Well, the intake is located at the front edge of the housing and is elongated along the front edge of the housing and it does not extend beyond the housing sidewise.

Q. Is it located in a zone of pressure?

72 It is.

Q. Does it comprise one row of apertures or two?

A. Two rows.

Q. What, if anything, intervenes between those rows?

A. There is a rib running down the center.

Q. Does that rib alter in any way the existence of pressure along the forward edge in which the apertures are located?

A. Not as it is made.

Q. Does the construction shown in these Plaintiff's Exhibits 17 and 18 have uniform pressure throughout the inlet?

A. It does.

Q. Is the organization such that that pressure is utilized to exist in circulating water through the cooling jackets of the engine?

A. It is.

The Court: We will take a short recess, gentlemen.

(A short recess was taken.)

Mr. Wheeler: Q. Will you please describe the location and structure of the water pump in reference to the lower unit as shown in the drawing of Evinrude patent No. 1,786,835, Plaintiff's Exhibit 15?

73 A. The water pump is located at this point, that is, next to plate C, and it is made in the form of a centrifugal water pump. It receives its water from opening 33 and the water goes up through 32 and enters the centrifugal impeller at 34. The water is then expelled from the centrifugal pump and goes up through a channel 45,

up to the engine. It goes through the water jackets of the engine, down through the water jacket on the muffler, and then it is dropped overboard.

Q. Is that water pump located above or below water level?

A. That water pump is located below water level.

Q. Is there any advantage in that?

A. It is always primed.

Q. Is priming necessary to a centrifugal pump?

A. It is.

Q. How is the chamber provided for this impeller of the centrifugal pump to which you have referred?

A. The chamber is formed by a lower surface that follows to the lower part of the gear housing and an upper surface that follows through the upper part of the housing.

Q. Please describe in more detail how the chamber is made between those surfaces?

74 A. We have two spaced walls, which leaves an annular space in which the impeller runs, and the anti-cavitation plate is enlarged in order to form that chamber.

Q. Is one of those walls flush with the surface of the anti-cavitation plate?

A. It is practically flush. The lower surface is practically flush with the anti-cavitation plate.

Q. So that the chamber is mostly formed in the upper section of the housing?

A. That is correct.

Q. On what is the impeller mounted?

A. The impeller is mounted on the vertical drive shaft.

Q. What is the speed of the vertical drive shaft with reference to the speed of operation of the propeller shaft?

A. In this particular device the pinion on the drive shaft is smaller than the gear in the propeller shaft, so that the propeller would turn at a slower rate of speed than the drive shaft.

Q. Is that conventional and is it desirable?

A. That is both conventional and desirable.

Q. Why?

A. In order to obtain enough power from the engine

75 you have to run the engine at a relatively high rate of speed. In most cases you will find a propeller running at that speed is not efficient.

Q. Just approximately, what would the relative rates of speed be in actual practice?

A. Somewhere around two-thirds on most of the outboard motors being built now.

Q. What is the engine speed, approximately?

A. The engine speed is approximately 4,000 r.p.m.

Q. And the propeller speed about two-thirds of that?

A. And the propeller speed about two-thirds of that.

Q. Is there any advantage in mounting the impeller on the shaft for a higher rate of speed?

A. Yes. The centrifugal pump, in order to pump water at all, must run at a relatively high rate of speed.

Q. Does this lower section carry a wall that forms one side of the chamber in which the impeller is located?

A. Yes. There is a wall extending from the lower portion of the housing up to the pump chamber that divides the housing and the forward chamber to conduct water and the rearward chamber to contain grease, in this particular construction.

Q. Does that construction exclude the water from

76 the gear chamber?

A. It does.

Q. Is that desirable?

A. Well, it is essential in order to keep dirt out of the gears and bearings.

Q. Does the water in which these devices operate contain dirt?

A. In many cases it does. It might be used in a sandy river.

Q. How is the shaft arranged in such a manner that dirt is prevented from following along the shaft into the gear chamber?

A. Well, the shaft is journaled in two bearings. It has a bearing just below the impeller, the water pump impeller, and there is another bearing just above the pinion bearing; below the water pump impeller is a solid bearing forming a relatively tight fitting around the shaft.

Q. Does the water have access to the shaft above that solidly fitted bearing?

A. In this particular device there is a sleeve around the shaft.

Q. Does that sleeve turn with the shaft or not?

A. Yes, it does.

77 Q. And the water surrounds the shaft about that sleeve, does it?

A. It does.

Q. How does the water get to the impeller?

A. The water is scooped by the scoop 33, goes up through the channel 32 and enters the impeller through an annular space 34 at the center of the impeller.

Q. Will you please locate that space with reference to the drive shaft?

A. It surrounds the drive shaft.

Q. What defines the outer periphery of that annular space through which water is admitted?

A. That is a portion of the gear housing.

Q. Is it identified on the drawing by any reference character?

A. Well, it is the portion marked 28, the inner edge of the portion 28.

Q. What relation has that horizontal partition 28 to the cavity or chamber ~~in~~ which the impeller is located?

A. That forms the bottom surface of that chamber.

Q. So that there is an annular opening in the bottom surface of the chamber in which the impeller is located?

A. That is correct.

Q. Please describe the form of that impeller.

78 A. The impeller is made in the form of a disk, with curved blades attached to one side.

Q. Which side?

A. The under side.

Q. So that the disk is at the top of the impeller and these blades depend beneath it; is that correct?

A. That is correct.

Q. What relation does that disk have to the top chamber in which the impeller operates?

A. That disk runs relatively close to the top surface.

Q. What does it do by reason of running close?

A. It runs close enough to seal the space between the impeller and the upper housing.

Q. Against what?

A. Against water leakage that would otherwise occur from the pump chamber up in the drive housing.

Q. When the impeller is in operation, is that space around the drive shaft immediately above the impeller subject to pressure or to partial vacuum?

A. If the seal is effective at the outer periphery, than there might be a partial vacuum at that point.

Q. Why?

A. Because of the centrifugal action of the impeller.

79 Q. Where does the water go from the pump chamber?

A. The water goes up through the channel 45 to a water pipe 48, up to the engine.

Q. What is the horizontal plan form of that pump chamber as shown in Figure 6?

A. That is shaped in the form of a spiral, starting with a small radius at this point.

Q. At what point, called what?

A. That is called the outlet, and gradually increasing in radius to the largest radius at the outlet.

Q. In what direction does that impeller turn as viewed in Figure 6?

A. That is anti-clockwise, as shown by the arrow.

Q. What is the effect of that spiral wall of the chambers, so far as water delivery is concerned?

A. It increases the efficiency of the pump.

Q. Do you know whether defendant's constructions, as exemplified in Plaintiff's Exhibits 17 and 18, use a centrifugal pump?

A. They do.

Q. Will you please refer to Plaintiff's Exhibit 8, showing the interior construction of the motor which is in evidence as Plaintiff's Exhibit 18, and describe the defendant's arrangement?

80 A. We have a water intake on the forward edge of the gear housing scooping water and the water is admitted through an annular space located at the anti-cavitation plate and leading the water into the center of the water pump impeller. There is a water pump impeller acting as the centrifugal pump, which forces the water out in a vertical channel, going up to the motor and cooling the motor in the conventional manner.

Q. How is the chamber formed in that device?

A. The chamber is formed between the lower section of the housing and the upper section of the housing, forming an annular chamber between those two sections.

Q. Is the cavity in which the impeller is located formed primarily in one section or the other, or is it located half in each?

A. It is formed primarily in the upper half.

Q. Is there a partition in the lower section of that lower unit which guides the water in its movement toward the impeller?

A. Yes, we have a partition starting at the drive shaft bearing and running up through the housing.

Q. Does the water surround the drive shaft above that bearing?

A. It does.

81 Q. And surrounding the drive shaft, which is located forwardly of that partition?

A. The drive shaft is located forwardly of the partition.

Q. And the opening into the impeller chamber bears what relation to the bearing?

A. The opening to the impeller is located above the bearing and there is an annular space around the drive shaft.

Q. What form has the pump chamber in that device?

A. It is formed with a spiral outside surface.

Q. Where does that spiral have its smallest radius with reference to the water outlet?

A. It has the smallest radius next to the water outlet.

Q. In what direction, as viewed in that section in Exhibit 8, does the impeller turn?

A. That impeller turns anti-clockwise.

Q. The same as in Figure 6 of the Evinrude patent No. 1,786,835?

A. That is right.

Q. What, if any, relation does that pump chamber bear to the anti-cavitation plate?

A. The pump chamber is located at and just above

82 the anti-cavitation plate.

Q. Does the pump chamber constitute an enlargement of the anti-cavitation plate?

A. It does. It is enlarged on the upper side of the anti-cavitation plate.

Q. You are now pointing to the view at the extreme right of Exhibit 8?

A. That is right.

Q. Will you please refer to Exhibit 5, which is a cross-section of defendant's smaller motor, Plaintiff's Exhibit 17, and describe that construction with reference to the pump and the pump chamber?

A. The water is scooped through a forwardly directed opening in the gear housing and rises in the gear housing and is admitted to a centrifugal pump chamber through an annular space at the anti-cavitation plate. The water is thrown out by the centrifugal pump, goes up through the

drive housing and then up through a water line to the engine and cools the engine.

Q. How is that pump chamber formed?

A. That pump chamber is formed by two co-acting walls, one wall being part of the lower part of the housing and the other wall being part of the upper part of the housing.

83 Q. What form does the side of that pump chamber have?

A. The side is formed spirally.

Q. Does it have the same form with reference to the outlet port that you have described with reference to Exhibit 8?

A. It does.

Q. What relation does the pump chamber bear to the anti-cavitation plate in this device?

A. The pump chamber is located at and above the anti-cavitation plate.

Q. What relation to the plate does it bear?

A. It is part of the plate and it is enlarged on the upper portion of the plate or above the plate.

Q. Is there in this device any partition between the water passage and the space in which the gears are contained?

A. Yes, the partition starts at the lower part of the water intake and extends up through the gear housing.

Q. What, if any, relation is there between that partition and the drive shaft?

A. Part of the partition forms the drive shaft bearing.

Q. Is the arrangement such as to exclude water from the space in which the gears are contained?

A. Yes.

84 Q. Why is that done?

A. The drive shaft passes through a solid bearing which is relatively water tight, and the bearing is the only opening between the water space and the gear housing that contains the gears.

Q. Why is water excluded from that space?

A. In order to exclude dirt.

Q. How is the water inlet to the pump chamber located with reference to that bearing?

A. The water inlet is located ahead of the bearing.

Q. I think you misunderstood. I referred to the water inlet to the pump chamber.

A. Oh, pardon me.

Q. With reference to the bearing.

A. The water intake to the pump chamber is located above the bearing and the intake is an annular space around the drive shaft.

Q. Whath form does that water inlet to the pump chamber take?

A. The water intake to the pump chamber is an annular space in the wall, the upper wall of the lower drive shaft housing.

Q. Is that the same opening through which the drive shaft extends?

85 A. Yes.

Q. What, if any, relation is there between the impeller and the upper wall of the pump chamber?

A. The impeller is mounted closely against the upper wall of the pump chamber.

Q. What function does it perform, if any, by reason of that mounting?

A. As a seal around the outside surface.

Q. In what part of the motor structure is the impeller mounted?

A. The water impeller is mounted on the drive shaft.

Q. By the drive shaft you refer to the vertical drive shaft?

A. Yes.

Q. Does that operate at or below engine speed?

A. That operates at engine speed.

Q. Now I will ask you to refer to Plaintiff's Exhibit 14, patent No. 1,869,749, and describe the exhaust pipe and its reference to the extension chamber.

A. That drawing shows a two-cylinder, two-cycle motor with the exhaust expansion chamber located behind the two cylinders. That expansion chamber is numbered 8. From the expansion chamber there is a tapered exhaust tube No. 10, starting with a big diameter at
86 the expansion chamber and having a small diameter down at the water level.

Q. What is the characteristic of a two-cycle engine with reference to the time of discharge of the two cylinders into the expansion chamber?

A. A two-cycle engine is made in such a way that the exhaust discharge occurs at the same time as a fresh charge is being transferred into the cylinder.

Q. How often does it occur with reference to the rotation of the crank shaft?

A. It happens once every revolution.

Q. And if there are two opposed cylinders, as shown in this patent, do the cylinders discharge consecutively or simultaneously into the expansion chamber?

A. Simultaneously.

Q. What is the effect of simultaneously discharging gas from both cylinders into the expansion chamber?

A. There is quite a pulsation in the expansion chamber every time the exhaust discharge occurs.

Q. A pulsation in terms of what?

A. Pressure pulsations.

Q. Where is that exhaust discharged?

A. The exhaust is finally discharged through the gear housing; in this particular construction, below
87 the water level.

Q. Will you refer to the drawing and identify the point of discharge?

A. The discharge is numbered 7. That is in the cavitation plate.

Q. What is the effect of such a discharge mouth with reference to exhaust pressures at that point in the course of movement of the device through the water?

A. When the device is moving through the water there is a suction created at the trailing edge of the anti-cavitation plate, causing a suction at that point.

Q. Have you had any experience with a motor corresponding in all respects to this, with the exception that it used a straight walled tube for a pipe between the expansion chamber and the under-water outlet?

A. Yes, I have.

Q. Will you please compare your experience with that motor and your experience, if any, with the tapered exhaust pipe as shown.

A. I was able to obtain much better motor performance with the tapered exhaust pipe than I could obtain with the straight walled type.

Q. In the same motor?

A. In the same motor.

88 Q. To what do you ascribe that improved performance?

A. I ascribe that to the reduction or elimination of pressure pulsations within the tube.

Q. What caused those pressure pulsations and how were they eliminated?

A. In a straight tube you might reach a frequency in the running of the motor causing a harmonic pulsation within the tube itself. With the tapered tube it is much more difficult to obtain that.

Q. Did you actually find that condition in your use of a straight tube in such a motor?

A. Yes.

Q. What effect did that pulsation have that caused inferior motor performance?

A. It caused exhaust back pressure and that reduces power.

Q. Will you describe in a little more detail just how that condition is brought about in a straight walled tube?

A. The pressure in the straight walled tube might travel from one end of the tube to the other and back again, and you might have pressures that are sub-atmospheric or higher than atmospheric at any particular point of that tube at any time.

89 Q. According to the location of that high pressure zone in the tube at the time?

A. That is right, and that depends on the speed of the motor, the length of the tube and the proportions of the tube.

Q. Would you regard the term resonant as a correct description of that condition that creates that pulsation back pressure?

A. Yes.

Q. In that condition does the pulsating back pressure affect the output of the engine?

A. That is when the speed of the engine coincides with the resonance of the tube.

Q. Where does the pulsating point of pressure have to be located in order to create back pressure with reference to the discharge of newly admitted gases from the cylinders to the expansion chamber?

A. If the high pressure area is at the top of the tube it would be most detrimental.

Q. Why?

A. Because then the high pressure area is closest to the engine exhaust ports.

Q. Does such an engine have high pressure at the exhaust ports?

90 A. Yes.

Q. Are the exhaust and intake open concurrently in a two-cycle engine?

A. The exhaust opens slightly before the transfer ports, but the exhaust port is open during the entire period the transfer port is open.

Q. Except for the moment when the exhaust port opens first, you have the engine both discharging burned gases and taking in fresh gases?

A. That is right.

Q. If during that interval when the engine is both taking in fresh gas and discharging burned gas there is a substantial back pressure, would that affect the running of the engine?

A. Yes. If there is a substantial back pressure then it is much more difficult to admit the new charge.

Q. Will you state whether your selection of a tapered exhaust pipe was based on actual experimentation?

A. It was.

Q. With what style and size of motor were you experimenting?

A. At the particular time when that was developed, we experimented with one 6-horse power motor and one 10-horse power motor.

91 Q. Were they twin cylinder motors with the cylinders opposed?

A. Yes, both of them were.

Q. Will you please state whether in either of defendant's structures you find a tapered exhaust pipe?

A. Yes, in Neptune 16-horse power, that has the tapered exhaust pipe.

Q. Plaintiff's Exhibit 18?

A. Yes.

Q. Does that exhaust pipe have an exhaust leading down to a point below normal water level?

A. It does.

Q. Does it connect at its larger end with the expansion chamber?

A. It does.

Q. Is that a two-cylinder opposed two-cycle engine?

A. It is.

Q. Is the discharge from those two cylinders delivered concurrently into the expansion chamber?

A. No; simultaneously.

Q. Is the condition that you see in that engine such as

to be calculated at the normal speeds at which that would operate to set up a back pressure if a straight exhaust pipe were used?

92 A. Yes.

Q. Which is more expensive to manufacture, a tapered exhaust pipe or a straight tubular exhaust pipe?

A. The tapered exhaust pipe is the most expensive.

Q. Why does it cost more than a tubular exhaust pipe of uniform section?

A. A tubular exhaust pipe you obtain as a drawn tubing, which is considerably cheaper than an expensive casting.

Q. Even if you had the dies or molds for making such a tapered pipe, would the tubular pipe of uniform section be cheaper?

A. It would.

Q. Is the outlet of the exhaust pipes in defendant's device directly rearwardly with reference to its path of movement?

A. Yes, it is directed rearwardly.

Q. In your opinion, does the tapered form of that pipe eliminate the form of resonance which you have described and which leads to objectionable back pressure?

A. Yes.

Q. Now referring to Plaintiff's Exhibit 16, Johnson patent No. 2,067,533, will you please describe that structure to the Court?

93 A. This drawing shows a spark plug cover which is fastened to the engine and covers the spark plug as well as the spark plug terminals. There are wires going from the spark plug to the ignition device.

Q. How many spark plugs are enclosed within this cover?

A. Figure 1 shows two spark plugs.

Q. And there are wires for each?

A. There are wires for each plug.

Q. Is there any advantage in thus enclosing a spark plug?

A. Yes; the spark plug is protected against spray and also touch. It is impossible for the operator to touch the high tension connections.

Q. Is there any objection to leaving the connections exposed for the operator to touch them?

A. Yes. You get quite a severe shock if you touch the terminals.

Q. Is it necessary that such a cover should exclude solid water such as might occur if the outboard motor were completely submerged?

A. No, that would not be essential in normal operation, it is only necessary to guard against spray or rain.

Q. What objection is there to having spray or rain lodge against the spark plug?

94 A. If it is salt water spray the plug would be shorted, due to the salt accumulation along the insulator.

Q. Why do you say salt water as distinguished from fresh water?

A. Salt is a conductor of electricity.

Q. What is used in this device to hold that cover either open or closed.

A. It shows a hinge at 20, referring now to Figure 2, and there is a spring 23 that keeps it in either open or closed position.

Q. In Figure 3 what arrangement is shown?

A. In Figure 3 there is a hinge at 33 and a catch, a spring catch at 30 or 35.

Q. How does that spring catch at 35 operate?

A. It holds the cover shut after it has been pushed into place.

Q. Does it require any tool to permit the cover to be opened?

A. No.

Q. In either of these constructions is a tool required to open that cover?

A. No.

Q. Is there any advantage in an arrangement which permits the cover to swing open freely?

95 A. The plugs are much more accessible if you want to get at them.

Q. Is that necessary or desirable in outboard motor practice?

A. The plugs in the two-cycle outboard motor are quite apt to foul, due to gasolene and oil mixture that is being used, and it is quite often necessary to get access to the plugs for cleaning.

Q. In a two-cycle engine the oil is generally mixed with gasolene?

A. Right.

Q. The plugs are exposed to the oil when the gasolene burns?

A. That is right. The oil is transferred to the explosion chamber.

Q. Is it sometimes necessary to get access to the plugs while the motor is in use on the water?

A. Yes, it is sometimes necessary. In this particular engine two plugs are shown. One might be fouled and the other might not be, and it might be necessary to find out which one was fouled.

Q. When you swing the cover on a hinge, is there any possibility of the cover touching the plug that is in operation in such a way as to short it?

96 A. Not the way this cover is constructed.

Q. If the cover were not mounted on a hinge but were bolted or otherwise secured, might the operator in manipulating the cover touch the plugs?

A. Yes.

Q. What would result if he did?

A. If he touched the plugs with the cover he might get a severe shock.

Q. In other words, the cover being conductive, a current might be conveyed to his own body?

A. That is correct.

Q. If the cover were merely bolted in place and were removed in open water while on the boat, what might happen?

A. Well, the screw or the bolt or the nut, whatever holds the cover in position, might be lost in the water, as well as the cover.

Q. What is the general position of such a cover with reference to the stern of the boat, is it over the boat or over the water?

A. It is over the water.

Q. I will show you a power head, which is not yet in evidence but is marked for identification as Defendant's Exhibit H, and I will ask you to describe what you

97 there find with respect to the spark plug and any cover which may be present.

A. There is a cover mounted on the side of the cylinder. It is hinged to the cylinder head and it covers the spark plugs and the wires run from the spark plugs to the magneto through an opening in the cover.

Q. Is the cover closely fitted to the engine at any point?

A. Yes, it is closely fitted at some points. It is relatively closely fitted to the bottom of the cylinder or along the back edge and also in front.

Q. Is it very slightly spaced from the cylinder?
A. It is slightly spaced in some places.
Q. Is it sufficiently close to the cylinder to exclude spray from the spark plugs?
A. It is.
Q. Are the openings that you have described so located that any spray would be apt to enter them?
A. The spray would not be apt to enter them.
Q. Does it protect the spark plug from accidental contact of the operator with the high tension current?
A. It does.
Q. Does it protect, not merely the terminals of the spark plugs, but also their bases?
98 A. It protects the whole plug, as well as the terminals.
Q. Does it also enclose portions of the wiring leading to the plugs?
A. It does.
Q. How, if in any manner, is that cover held in any position?
A. There is a spring hinge at the back edge of the cover and in a closed position there is a spring snap.
Q. Is it the spring hinge in that sample before you, or the plain hinge?
A. That is a plain hinge.
Q. How does that snap operate, is it simply a detent or does it require a tool for its manipulation?
A. It is a detent. You can push it shut and pull it open.
Q. The way that cover is mounted, are there any loose parts which might be lost if the cover were open while the motor is on a boat?
A. There are no loose parts.
Q. Do you regard the cover on this Defendant's Exhibit H for identification as substantially serving the purpose of the structure shown in the patent, Plaintiff's Exhibit
99 16?
A. I think it does.

Mr. Wheeler. We rest with this witness, your Honor.

The Court: We will recess at this time, gentlemen, until 10:00 o'clock Monday morning.

Whereupon an adjournment was taken until Monday, January 29, 1940, at 10:00 a. m.

100 Monday, January 29, 1940
10:00 o'clock A. M.

Court convened pursuant to adjournment.

Present:

Messrs. Wheeler, Wilkinson, Rummler.

FINN T. IRGENS resumed the stand.

Cross-examination by Mr. Rummler.

Q. I believe you testified that you are familiar with all of the structures disclosed in the seven patents here in suit. Is that so?

A. That is so.

Q. Have you read all of those patents and are you familiar with the terms of the claims and what is described in all of those seven patents?

A. Yes, I am.

Q. Mr. Irgens, what is meant by the term cavitation as it is applied to outboard motors?

A. Cavitation, as applied to an outboard motor, is sucking air down into the slip-stream of the propeller. You can, of course, cavitate without sucking air into the
101 propeller, but there may be a resulting void or vacuum, but as applied to an outboard motor it is air that is really the disturbing factor.

Q. That air comes from where, Mr. Irgens?

A. From the surface.

Q. How far below the surface must the propeller be to avoid cavitation?

A. That depends entirely on conditions, the size of the propeller, the amount of power. It should be fully submerged, of course.

Q. Could you state that distance in terms of diameter of the propeller?

A. No, I could not, because, as I said before, it depends entirely on conditions. We have racing motors where the propeller is very large and say, submerged about half an inch, and we have service motors that leave the propeller submerged a whole lot further than that.

Q. How does the anti-cavitation plate avoid cavitation?

A. It seals or obstructs the path of the air going from the surface down into the propeller slip-stream.

Q. Well, in that case, with the propeller near the surface, as in a racing motor, where must the anti-cavita-
102 tion plate be located to function as an anti-cavitation plate?

A. The anti-cavitation plate is located above the propeller.

Q. In a racing motor then, the anti-cavitation plate would be substantially at the surface?

A. Substantially at the surface, but there is always water above the plate to be effective.

Q. Well, assuming that the water surface were smooth, that is, there is no turbulence, would the anti-cavitation plate function to prevent cavitation if it were lying at the surface?

A. Of course, then, you have to assume that the water is absolutely smooth.

Q. Yes.

A. But even then it would be awfully difficult to conceive of that condition because air would be sucked around the edges of the plate very much easier than if water was present.

Q. That would depend somewhat on the size of the plate, wouldn't it?

A. Oh, yes.

Q. Mr. Irgens, with any outboard motor is the water line always the same under all conditions of use, that is,
103 with respect to the propeller?

A. No, the water line will depend on the boat, the height of the transom. Outboard motors are portable and demountable. You might take a motor from one boat and put it on another boat. In that case, of course, the water line would change.

Q. Often then, the entire lower unit of the outboard motor might be wholly submerged?

A. Yes, it could be. Of course, to obtain the best efficiency of the motor you would not go beyond reason. Most outboard motor boats now are made with transoms that will fit the average motor on the market.

Q. But the location of the water line would be practically dependent on the kind of boat on which the motor is mounted?

A. That is correct.

Q. Mr. Irgens, what is an eddy current?

A. An eddy current might be described as a swirling current in the water.

Q. How would that swirling current be produced?

A. It could be produced by moving an object through the water.

Q. If that object had any obstructions on its side surfaces or if it were a square section, would you have
104 eddy currents?

A. Very apt to have; yes.

Q. Then what is the purpose of providing smooth and stream lined surfaces in section?

A. That is to eliminate as far as possible the volume of eddy currents.

Q. Is that the principal reason for stream lining?

A. The principal reason for stream lining is to reduce the resistance to movement through the water.

Q. What causes that resistance to movement through the water?

A. The displacement of water and also the formation of eddy currents.

Q. Would you say that the resistance created by eddy currents was of greater extent than that produced by skin friction?

A. It could be under certain conditions; yes.

Q. Then in your opinion why was stream lining developed?

A. As I have said before, to reduce resistance to motion through the water.

Q. And to obviate as much as possible eddy currents?

A. Yes.

Q. To your knowledge, Mr. Irgens, how old is the
105 art of stream lining, that is, as applied to under-water parts?

A. As old as the world, I imagine. A fish is stream lined.

Q. Mr. Irgens, I have here a device that is marked for identification as Defendant's Exhibit B, and ask you if you recognize that?

(The device was so marked.)

A. Yes, that is a gear housing and drive shaft housing used on an Elto motor.

Q. Could you say about when that motor was made?

A. That was made in 1924.

Q. Mr. Irgens, would you say that this stem portion was stream lined?

A. Within the sense as used in the outboard motor industry it would be; yes, sir.

Q. And it has smooth side walls?

A. Yes.

Q. About where would the water line come on this device?

A. I would say somewhere within that range in there.

Q. Then you would say that the smooth walls extend well above the normal water line?

A. Yes, I would.

106 Mr. Rummler: For the sake of the record in locating the water line on this Elto device, Mr. Irgens stated that the water line would fall above the rudder hinge and below the top of the rudder.

Q. Mr. Irgens, are you familiar with the Evinrude patent No. 1,567,127 that is one of the patents in suit?

A. I may be, if I saw it. I cannot recall the number.

Mr. Wheeler: If your Honor please, I question whether there should be cross-examination concerning a patent not cited in the answer.

Mr. Rummler: This device is shown, Mr. Wheeler, exactly in the Evinrude patent.

Well, I will withdraw the question.

Q. Mr. Irgens, in your opinion, why was this device shaped as it is, that is, this stem portion?

A. To make it an efficient water propulsion device.

Q. If you were going to put an anti-cavitation plate on this device, where would you locate that anti-cavitation plate?

A, Approximately at the upper rudder hinge.

Q. That would be right in there (indicating)?

A. Yes.

Q. How would you fasten that anti-cavitation plate?

A. On a housing of that type, that is a sand casting,

107 and the easiest way would be to cast it on to the housing.

Q. As an integral part?

A. Yes.

Q. Mr. Irgens, referring to this chart which I have mounted here, which shows the drawings of Johnson patent No. 1,763,970, Plaintiff's Exhibit 11, how would you determine where the water line is located?

A. You mean from experience?

Q. From your experience and from the drawing.

A. From experience, the water line would be located somewhere between the anti-cavitation plate and the top of the stream lined portion, approximately half-way between there would probably be a good point for it.

Q. That would be in what you consider to be normal, proper use?

A. Yes.

Q. In the mounting of the motor?

A. Yes.

Q. But with that device there the water line would vary considerably, depending on the kind of a boat on which it was mounted, would it not?

A. Yes.

Q. And it might even be wholly above this propeller
108 casing, might it not, in some conditions?

A. It could be. Of course, that would be a misuse.

Q. Where would the water line be if that motor were driving a boat at its maximum speed, that is, the maximum speed for that type of motor?

A. With a construction like that, if you have water present over the plate, that would be a proper condition of operation.

Q. Just so long as the plate is under water?

A. The plate should be covered by water; yes. The only reason, of course, for stream lining this portion from the plate up to the flange is to provide for a range of driving depths.

Q. In your direct-examination, Mr. Irgens, I believe you testified that in the defendant's device the leading edge, the portion below the anti-cavitation plate, was blunt?

A. Yes.

Q. Now referring to Plaintiff's Exhibit 9, tell me where you find a bluntly rounded leading edge on that portion below the anti-cavitation plate?

A. The portion in here (indicating) will give the same effect as a rounded edge. It is blunt.

Q. What do you mean by blunt?
109 Well, as differentiated from sharp, it would be a broader nose.

Q. It is a relative term, then?

A. Yes.

Q. And in devices of the nature of that shown in Plaintiff's Exhibit 9 that bluntness would be relative to what?

A. It would be relative to the maximum thickness of the housing, as well as the length of the housing.

Q. Would it be relative to the trailing edge, also?

A. Yes.

Q. That is, in a normal stream lined section of an under-water part?

A. The particular patent in question differentiates between the sharp trailing edge and the blunt forward edge.

Q. You are familiar with the conventional pear-shaped stream lined section for an under-water part, are you not?

A. Yes, I am.

Q. So the blunt end would be blunt relative to the trailing edge of such a section?

A. Yes.

Q. Mr. Irgens, I hand you a printed copy of Pierce
110 Reissue patent no. 18118. In your direct-examination
you located the water line as falling between the numerals 16 and 18 on the drawing?

A. Yes.

Q. How did you arrive at that conclusion?

A. There is nothing in the drawing to indicate it. I drew that conclusion from my own experience. That would be the proper place for the water line.

Q. Is that from your long experience in operating devices like that shown in the Pierce patent?

A. That is correct.

Q. Mr. Irgens, where, in the specification of this Pierce Reissue patent No. 18,118, do you find anything to indicate the location of the normal water level on the Pierce device?

A. Offhand, I cannot tell you that because it is quite a while ago since I read the specification and I do not really know whether that statement appears in the description. I can read it through and see if I can find it for you.

Mr. Rummler: I do not think that is necessary now.

Q. Looking at that drawing of the Pierce patent, how far below the water level would the propeller be if the
propeller were between the numerals 16 and 18 as you
111 have located it?

A. If you assume that is about a 7-inch diameter propeller, which is common in an outboard motor, then it might be about two and a half or three inches.

Q. Would there be much anti-cavitation with the Pierce device that you have described with the propeller about two and a half or three inches below the water level?

A. No, if the power is limited and the housing is well proportioned in relation to the power, you could operate a device like that without cavitation.

Q. Would you be able to drive such a device at very high speed without cavitation?

A. You could drive it at extremely high speeds without cavitation.

Q. With the propeller only about two and a half or three inches below the water level?

A. Yes.

Q. Supposing you had a 9-horse power motor driving that device shown in the Pierce Reissue patent, would there be apt to be cavitation?

A. Yes, there would be apt to be cavitation under those conditions.

Q. Mr. Irgens, where would you locate the anti-cavitation plate on the Pierce device to prevent cavitation?

112 A. I would say just about half-way between the numeral 18 and the top of the propeller, preferably a little closer to the propeller. That is common practice, to place an anti-cavitation plate as close to the propeller as practicable.

Q. Then the anti-cavitation plate would perhaps be about an inch and a half below the normal water line?

A. Yes.

Q. How would you mount or fasten the anti-cavitation plate on the Pierce device?

A. With the Pierce device as shown in Figure 1 and Figure 2, it would be a casting, and in that case I would cast the anti-cavitation plate on to the housing.

Q. As an integral part of the structure?

A. As an integral part; yes, sir.

Q. Mr. Irgens, in an outboard motor device built like this disclosed in the drawing of the Pierce Reissue patent, how much area would you say there would be in the under-water part?

A. Well, I referred a while ago to the propeller that might be about seven inches in diameter.

Q. Yes, referring to a 7-inch propeller.

A. Might be about thirty square inches.

Q. How much area in an under-water part would

113 you say would be necessary to steer a motor having a 7-inch propeller and, say, a 9-horse power motor?

A. With an under-water housing like this, of course,

you only steer after the power is shut off. That is the only time when the rudder effect is needed, and with your housing as shown in the Pierce patent, you would have the steering effort after you shut the motor off because you can only get steering as long as the boat has forward motion.

Q. Mr. Irgens, when the motor is stopped while the boat is under way, how does the dragging propeller affect the steering?

A. The dragging propeller won't affect the steering but it will tend to slow the boat down.

Q. But you would still be able to control the direction of the boat by a housing such as shown in Pierce?

A. As long as the boat has headway.

Q. Do you know that from your own experience with devices of that nature?

A. Yes, I do.

Q. Mr. Irgens, do you know what proportion of the total steering effect is produced by the propeller slip-stream and what proportion is produced by the area of the under-water part, that is, referring to the Pierce
114 disclosure?

A. I would say that the steering effort of the housing is of no importance when the motor is running. In other words, the steering effort from the propeller itself is much more important than the steering you get from the housing while in operation.

Q. You say you have operated motors similar to this disclosed in the Pierce Reissue patent? Would you describe when you shut the motor off after the boat has been speeded up; let us say you are coming into the dock at normal cruising speed, and you shut the motor off. What happens?

A. The boat speed will slow down, depending on the shape and load of the boat, and eventually you come to a stop.

Q. Is that slowing down rather sudden?

A. It depends entirely on the hull.

Q. Does the under-water part of the outboard motor have any effect on that slowing down?

A. The propeller has. That would put a brake on the boat.

Q. After the motor is shut off, how effective is this steering; do you have complete control of the boat?

A. That is also a relative term. You can change
115 the course of the boat by using the housing as a rudder.

Q. But it is only a small fraction of the amount of steering that you would have if the motor were going; is that right?

A. Absolutely.

Q. Have you ever operated one of defendant's motors in normal use for the propulsion of a boat?

A. Yes, I have.

Q. Have you ever operated either the 9-horse power or the 16-horse power motor, Plaintiff's Exhibits 17 and 18?

A. Yes.

Q. Mr. Irgens, referring to the Arndt patent, Plaintiff's Exhibit 15, which is the water inlet patent, and also referring to Plaintiff's Exhibit 9, which shows the lower unit of the 16-horse power motor, what would be the direction of the stream lines after being split by the rib or leading edge of the defendant's motor, as shown in Plaintiff's Exhibit 9, that is, the rib in front of the water inlet openings?

A. You are asking about the direction of the water after it has been split by this rib?

Q. Yes.

A. The water would flow down alongside of the rib
116 until it hits the blunt portion. Part of it would go
into the water intake and the rest of it would go around the housing.

Q. Have you ever conducted any stream line tests on a section like that to see just how the stream lines would go?

A. Not on that specific section; no. But the water would naturally have to follow along the side of the rib. Otherwise, you would have a void in there.

Q. Do you know that there would be no void produced just back of the leading edge of this rib and in this corner between the face of the inlet and the side of the rib?

A. No, I do not know that there would not be a void, because that depends entirely on the sharpness and thickness of the rib, also the speed.

Q. And also the width of the inlet area?

A. That is correct.

Q. So it is quite possible that there would be a void there, is it not?

A. It is possible, but not probable, because if the void

was big enough you could not get water into your water cooling system.

Q. What would you say prevented that void in a
117 motor such as shown in Plaintiff's Exhibit 9?

A. By making the rib narrow enough and sharp enough.

Q. Would not the width of the inlet area affect that, too?

A. I cannot see where that would have any effect on it.

Q. Well, suppose you had a rib with a sharp knife-edge and an inlet width there on the side of, say, one inch. Would you be apt to have a void in the corner between the rib and the inlet?

A. No; while you see the rib has a sharp edge, you also see the rib is very thin.

Q. Yes.

A. I do not think then there would be any void.

Q. Mr. Irgens, where is the forward apex of the exterior surfaces of the lower portion of the under-water part in the device shown in Plaintiff's Exhibit 9?

A. Are you referring to the blunt section of the housing?

Q. The leading edge.

A. This portion down here hasn't got any apex; if you refer to this portion in here, to the upper portion of the stream lined section below the plate, then the apex would be along the front edge.

Q. And the rib then is a continuation of that apex,
118 is it not?

A. As shown in this particular drawing, it is a continuation of it; yes.

Q. As it is on defendant's motors, Plaintiff's Exhibits 17 and 18?

A. Yes.

Q. It is a continuation also, isn't it?

A. Yes.

Q. Where are the inlets located in defendant's devices with respect to the apex of the side surfaces?

A. Well, of course, I told you that I did not consider there was an apex in this section of the housing where the water intake is, but the water intake is in the front surface of the blunt portion of that housing.

Q. Mr. Irgens, the leading edge of this rib in front of the inlet openings would be the apex of a fair line following the side contour of this under-water part, would it not?

A. Yes, if you want to continue that and make it a sharp housing.

Q. And considering the apex as being at the junction of these fair lines of the sides, where would the inlets be located?

A. The inlets would be behind that.

119 Mr. Wheeler: Object to that as calling for a hypothetical situation that does not exist in their motor.

Mr. Rummler: Your Honor, it is not a hypothetical question at all, because this drawing clearly shows the contour of the side surfaces of the housing, and a continuation of these lines would meet at the rib. So, as a section and the converging side contour lines of this housing meeting at an apex, they would meet at the leading edge of that rib.

Mr. Wheeler: He said they would meet, but not that they did meet. It is hypothetical.

The Court: What is the question?

Mr. Rummler: Will you read the question?

(The question was read.)

The Court: Overruled.

Mr. Rummler: Q. Will you answer that question?

A. The intake would be located behind the apex.

Q. Referring to Plaintiff's Exhibit 8, will you point to the portion or the part of the sections shown and indicate where the apex is above the water inlets.

A. The apex would be at that particular point, this top of this cross-section, and at this particular point in the other cross-section.

Q. The section through that portion of the housing

120 where the water inlets are, shows how the fair lines of the side wall contour would meet at the same apex, does it not?

A. This particular drawing does show some continuations of the stream lines, and those lines would meet at that particular point (indicating).

Q. Mr. Irgens, would the pressures be uniform throughout the area included by the inlet in defendant's devices?

A. Within practical values; yes. The top of the inlet, of course, is closer to the surface of the water, but the pressure, due to the submersion of the housing, is relatively low as compared to the pressure exerted by the forward motion of the housing.

Q. Then the forward motion of the housing would produce what might be termed a velocity pressure?

A. That is correct.

Q. And the pressure produced by the housing being submerged, or the height of the water, whatever it might be, would be considered as static pressure?

A. That is right.

Q. Would you say that the velocity pressures would be uniform over the area included at the inlets in defendant's devices?

121 A. Within practical values.

Q. What do you mean by practical values?

A. You might have a slight effect from the cigar shaped housing below, that might affect the values, but considered as a velocity pressure, I would say they would be normal throughout the height.

Q. Then, Mr. Irgens, if that were the case, would the pressures be uniform over the area of any shape located at the forward part of the housing and above this barrel-shaped portion you just referred to?

A. No.

Q. That is the velocity pressure I am talking about.

A. Yes. If the intakes are within the same zone of pressures on the housing, then, of course, it will be equal, but if you extend them around the stream line they could not be.

Q. I am referring to an inlet opening where the inlet is substantially all in one plane that would be normal to the fore and aft axis of the under-water part?

A. I would say there would be.

Q. Even if that opening were triangular in shape?

A. You might get some differences in the corners and might have a little difference in the edges, but so far as being able to lift water up to a pump, you have to
122 consider them equal.

Q. Mr. Irgens, referring to the Pierce Reissue patent No. 18,118 again, would you say that the pressures would be uniform over the inlet shown at 14 in the patent?

A. No, I don't think they would.

Q. Why wouldn't they be?

A. The rear portion of the intake is so far back or toward the rear that there is very apt to be suction at that point.

Q. Suction produced by what?

A. By water going past the stream line.

Q. Wouldn't you say that it is the projected area of

that opening that is in a vertical plane that would determine the area over which there would be uniform pressure?

A. No.

Q. You say that you get suction there because of the forward pointed curvature of that barrel-like portion of the housing?

A. Yes.

Q. That is where the propeller shaft is located?

A. You are apt to have suction. It would also depend on the speed, of course.

123 Q. Would not the same result be produced by the vertical rib forward of and separating the inlet in defendant's devices, as shown in Plaintiff's Exhibit 8?

A. No, if you refer to the motors themselves, then it would not, and as I mentioned before, the relative dimensions are going to be quite important, but as made by the defendants, it would not.

The Court: What was your original question about 18,118?

Mr. Rummler: Will you read that question?

(The question was read as follows: "Mr. Irgens, referring to the Pierce Reissue patent No. 18,118 again, would you say that the pressure would be uniform over the inlet shown at 14 in the patent?")

The Court: And the answer was no, because part of it was so far back?

The Witness: Yes.

The Court: But you would get suction?

A. That is right. The housing would split the water and the water would have a tendency to go sidewise away from the housing, like we have from the bow of a ship; if you go fast enough, you have a suction at that point.

The Court: All right. Go ahead.

124 Mr. Rummler: Q. Mr. Irgens, why, in your opinion, did Mr. Arndt make his inlet transversely narrow and vertically elongated?

A. In order to interfere as little as possible with the stream line you have to make it relatively narrow, in order to provide enough water intake should you encounter leaves or weeds, you have to make it long enough so there will always be ample space for that water to enter.

Q. What determines the natural area for an underwater inlet?

A. The size of the motor you have to cool.

Q. That is, the quantity you have to pass through it?

A. Correct.

Q. And that space would differ whether you had a pump or whether you had no pump?

A. That is correct.

Q. How would you arrange an inlet having the same total area of Arndt's inlet in the forepart of a stream line under-water housing in some other way than Arndt did it?

A. Well, you could put the water intake into the anti-cavitation plate itself in a horizontal direction and make it effective. That has been done. On the other
125 hand, Arndt's method of accomplishing an efficient water intake is absolutely proper and is the simplest way of doing it.

Q. That is the simplest and most apparent way of doing it?

A. Yes.

Q. Now Mr. Irgens, we will refer to this Evinrude patent No. 1,786,835, which is the pump patent, and also referring to Plaintiff's Exhibit 5 with respect to the pump arrangement in defendant's devices, particularly as examplified by Plaintiff's Exhibits 17 and 18. Have you carefully examined those devices as to the interior arrangement and construction?

A. Yes, I have.

Q. Have you read the Evinrude patent No. 1,786,835, and are you familiar with its disclosure and the terms of its claims?

A. Yes, I am.

Q. In your examination of defendant's structure, did you find that the disk or back plate of the pump impeller bears against the upper wall of the pump chamber?

A. If you refer to it as rubbing against the bearing, it might not have, but it was close to the wall.

Q. It was close, but there was clearance?

126 A. There could have been clearance, yes, but it would be very small if there was any.

Q. Did you find any clearance in the walls of defendant's motor?

A. I did not look for clearance.

Q. Mr. Irgens, did you find that the vanes of the pump impeller had any wiping contact with the peripheral wall of the pump chamber?

A. They did not touch the wall of the pump chamber,

but they ran close enough as not to permit the water to pass through in any quantity.

Q. But they did not touch?

A. They did not touch; no.

Q. Referring to Plaintiff's Exhibit 5, please point out where the drive shaft passes loosely through an opening in the upper wall of the pump chamber of defendant's device?

A. The shaft runs down through the upper wall at this particular point (indicating).

Q. Would you say that shaft was loose in that opening?

A. It is loose enough to turn in the opening, and it must turn.

Q. There is a bearing in that opening?

A. There is a bearing in that opening.

127 Q. Referring to Evinrude patent, Figure 2, sheet 3, where do you find a shaft passing loosely through an opening in the upper wall of the pump chamber?

A. At this point here, numbered 40.

Q. Do you find a bearing at that point?

A. There is a bearing shown.

Q. There appears to be considerable clearance. About how much clearance between this flange 26 and the shaft would you say there is?

A. Oh, there might be a quarter of the shaft diameter as shown there.

Q. Then that shaft really passes through that opening loosely?

A. It is loose; yes.

Q. In your understanding of the Evinrude patent, Mr. Irgens, would you say that the term "loosely" applied in the same sense to both the upper and lower openings in the device shown in the Evinrude patent?

A. Well, there is a space shown in the upper wall, as well as in the lower wall, through which the shaft passes.

Q. And that space is enough so that there might be some lateral whip to that shaft; isn't that so?

A. There could be, of course. The bearing is rela-
128 tively close to the lower opening.

Q. Will you point to that bearing, Mr. Irgens?

A. The bearing extends from this particular point down to here (indicating).

Q. Referring to Plaintiff's Exhibit 5, please point out

where you find a water supply passage partitioned from the drive shaft in the forward part of the shaft housing in defendant's devices.

A. Well, we have a water supply passage coming in here and running up to the pump chamber. The drive shaft starts from that point and goes all the way up to the motor. Now there is a partition wall at that particular point; also a vertical partition wall at that point (indicating).

Q. And that partition only extends part of the way up that shaft, does it?

A. Yes.

Q. So that the inlet passage then is partitioned from the shaft throughout its whole length, is it?

A. No.

Q. So the water passing through that inlet would pass around the shaft and contact the shaft?

A. That is correct.

Q. In the Evinrude device, as shown in Figure 3,
129 how is the water partitioned from the shaft, the
water inlet?

A. We have the same vertical wall surrounding the drive shaft at that particular point, and also down here (indicating).

Q. In the Evinrude device, though, it extends quite a ways above that shown in Plaintiff's Exhibit 5, does it not?

A. Yes, it does.

Q. Do you have any other means of preventing water from contacting the shaft in the Evinrude device?

A. In the Evinrude device there is a sleeve shown around the shaft from the pump impeller and down to the bearing.

Q. Mr. Irgens, referring to Plaintiff's Exhibit 5, in what way do you find the pump chamber or housing of defendant's 9-horse power motor constitutes an enlargement of the anti-cavitation plate?

A. I think it is plainly shown in the view on the right hand side. The anti-cavitation plate is shown as a flat plate and the pump chamber is shown as an enlargement above it.

Q. It is in the housing of the pump, or rather is it
an enlargement of the upper portion of the stem
130 adapter, that is, that part above the anti-cavitation
plate rather than the enlargement of the anti-cavitation plate?

A. It appears to me as an enlargement of the plate. The plate is thickened at that point and it extends quite a distance to each side of the drive shaft.

Q. In what way is it thickened at that point?

A. The plate is thickened in a vertical direction and the pump chamber extends out horizontally, too.

Q. Do you consider a pump chamber will serve the function of an anti-cavitation plate in any way?

A. Yes, it could. I would not call it an efficient plate.

Q. Do you think it does?

A. Yes, I think it does.

Q. In defendant's device?

A. Yes.

Q. Do you consider that bulging form of the pump housing to be stream lined in defendant's devices?

A. No.

Q. Then would you say that that pump housing was an interruption of the stream lining of the defendant's devices?

A. Of course, when you ask questions like that, they
131 are all relative. It depends on the speed at which you are running through the water.

Q. Always considering the average normal speed?

A. I would say this: The pump housing is less stream lined than the sections above and below it.

Q. Does that pump housing have any disturbing effect upon the stream lines as they pass the unit while it is going through the water?

A. They must.

Q. In other words, does the pump housing create any eddy currents?

A. It is apt to at certain speeds; yes.

Q. Have you ever observed in the operation of defendant's devices what the effect of the pump housing bulge is on the flow of water past at, let's say, high speeds?

A. No.

Q. Mr. Irgens, are you the patentee of United States Patent No. 1,869,749, which is Plaintiff's Exhibit 14? That is the exhaust tube patent.

A. Yes, I am.

Q. I do not think we have a chart of that. Mr. Irgens, in your experiments leading up to your adoption of a tapered exhaust tube, what was the tapered tube you
132 experimented with made of?

A. We experimented with cast tubes, as well as sheet metal tubes.

Q. Were the cast tubes that you experimented with both cylindrical and tapered?

A. Yes.

Q. Did you note any differences between the cast tube and the sheet metal tube with reference to resonance?

A. No.

Q. When you speak of resonance, are you referring to sound waves or pressure waves?

A. The way we have referred to it amongst ourselves it is a pressure wave within the tube, not the resonance of the casting or the sheet metal, as far as carrying sounds through it; it is the vibrations within the tube.

Q. How would you define the resonance that you are considering in this exhaust tube?

A. It is the pressure oscillation throughout the length of the tube.

Q. Mr. Irgens, what relation is there between the ratio of the end areas of a tapered tube and the frequency of exhaust impulses or discharges?

A. I have no records of that. The experiments we carried on were done on a purely cut-and-try basis
133 and we adopted what we found to be best.

Q. You kept no records of the relationship of the areas to the frequencies?

A. We kept records, but these tests were made in Jackson, Michigan, and I have been unable to find them after we moved over to Milwaukee.

Q. And it was by cut-and-try methods that you arrived at the proportions?

A. That is correct.

Q. Does the length of the tapered tube have any effect upon the power of the tube to be destructive of resonance?

A. Yes, from my experience I would say it would have.

Q. What is that effect?

A. It might be wrong. In other words, you might make the tube too long or you might make it too short.

Q. Is there any relationship between the length of the tapered tube and the ratio of the end areas of the tube?

A. I think you would find that if you carried through a series of experiments; yes.

Q. But you don't know of any?

A. No, I do not.

Q. Have you conducted any tests of defendant's ex-
134 haust tube?

A. We tried to make a test, but, due to other rea-

sons, we were unable to complete it. We tried to do that recently and the harbor was full of ice and we could not make a satisfactory run.

Q. So then you do not know that defendant's exhaust tube, as shown in the drawing Plaintiff's Exhibit 8, would actually be destructive of resonance, do you?

A. From my experience with the previous device, I would say that it would be.

Q. That is an assumption though, Mr. Irgens, is it not?

A. It is an assumption based on the experience I have; yes.

Q. What is it that leads you to believe that defendant's exhaust tube would be destructive of resonance?

A. Because it is made of proportions similar to the pipes we experimented with.

Q. How do you determine that a certain tapered tube is destructive of resonance, to pulsation frequencies?

A. The easiest way to do that is to try it.

Q. How do you determine the dimensions for a tube such as to be resonant to the frequencies of pulsations occasioned therein by the engine exhaust?

135 A. The easiest way to find out the beneficial results is to make up different sizes and try them and then take the best one.

Q. What is the ratio of the areas of the ends of the tapered portion of defendant's exhaust tube as shown in Plaintiff's Exhibit 8?

A. I have never measured that, but from the drawing you could assume that the diameter at the top is slightly more than twice the diameter at the bottom, and that would give you an area that would be better than four times as great on the big end over what you have on the small end.

Q. About four to one?

A. Approximately, by looking at the drawing there.

Q. How long is the length of the tapered portion of the exhaust tube in defendant's device?

A. I am just guessing.

Q. Just give it in proportion to the entire length.

A. You can say the tapered portion is about half of the length of the under-water structure and it probably brings it somewhere between twelve and fourteen inches.

Q. About half of the length of the total tube?

A. Well, it is a little bit greater than half of the length of the total tube.

136 Q. Just a little bit greater?

A. Yes.

Q. Mr. Irgens, in your patent you state that the ratio of the upper end area to the lower end area may vary from four to one to thirty-six to one. What is it that makes the end area ratio of four to one the lowest limit for a tapered exhaust tube that is destructive of resonance to pulsation frequencies?

A. When we conducted our experiments we limited the experiments to practical dimensions and four to one is a practical dimension which we tried and used.

Q. It might work on three to one, though?

A. It might; yes.

Q. So it was just from the standpoint of practical dimensions that you set the lower limit of four to one?

A. That is correct.

Q. Why would that cause you to set the end area ratio of thirty-six to one to be the upper limit contact above the exhaust tube that is destructive of resonance to pulsation frequencies?

A. If you go any further than that you get a design that is pretty much of a misfit. You may have an area at the bottom of the tube that will permit all exhaust to escape and you cannot have more than a certain
137 diameter, and you cannot have more than a certain diameter of the tube at the upper point to come within practical dimensions.

Q. To have a lower end area then, of sufficient size to let this exhaust out you couldn't very well have a ratio of thirty-six to one on the motor shown in Plaintiff's Exhibit 8, could you?

A. Not as shown, but we have run exhaust tubes with entirely different relative dimensions than shown on that drawing effectively.

Q. Then how do you arrive at dimensions for the exhaust tube in a certain motor; is it to fit the appearance of the motor?

A. The appearance has quite a bit to do with it, but the main object in designing an efficient exhaust tube is not to lose power.

Q. That is, to avoid as much as possible building up any back pressure?

A. That is correct.

Q. Mr. Irgens, how did you arrive at the dimensions of four and a half inches for the diameter of the large end

and one and thirteen sixteenths inches for the diameter of the small end of the tube described in your patent?

138 A. As I told you before, that was done by experiments.

Q. Cut-and-try?

A. Cut-and- try.

Q. And you just used that method?

A. That is correct.

Q. What was the length of that tube that you designed as a result of those experiments?

A. Oh, offhand I would say that tube must have been, oh, maybe eighteen inches.

Q. That is, it extended about from the cylinder heads down to the anti-cavitation plate?

A. To the gear housing.

Q. Or the gear housing.

A. Yes.

Q. Did you experiment with tubes tapered for only a part of their length?

A. Yes.

Q. What was the frequency of pulsations for which you used the tubes described in your patent, that is, the four and a half inch top diameter and one and thirteen sixteenths inch lower end diameter?

A. The particular motor that we ran at that time turned at 4,000 r.p.m. and that particular tube was very well suited for that motor.

139 Q. Is the exhaust tube described in your patent No. 1,869,749 tapered throughout its length?

A. As shown in the patent it is; yes.

Q. Mr. Irgens, what is meant by the expression in claim 1 of your patent, "said pipe having a submersible outlet movable in accordance with the operation of said engine and directed rearwardly with reference to its path of movement."

A. That refers to the outlet in the anti-cavitation plate where the exhaust is expelled into the water.

Q. That is the ultimate outlet for the exhaust tube?

A. Yes.

Q. What does that expression mean when you say "movable in accordance with the operation of said engine"?

A. The engine is being pushed through the water by the propeller and the water rushes past the opening above and also below it.

Q. Well, any exhaust tube would be movable with the engine, wouldn't it?

A. Yes.

Q. That is, you would not leave it at the dock; it would follow the engine?

A. That is right.

Q. When you used that expression in your claim 1,
140 didn't you mean that when the engine was turned for steering the exhaust tube outlet was also turned so as to always be in a common plane with the engine?

A. No, that was not the idea. The idea was to move the exhaust outlet through the water by the action of the propeller propulsion.

Q. Well, you said, "said pipe having a submersible outlet movable in accordance with the operation of said engine." Why was that inserted in the claim? You would naturally carry the inlet along with you wherever you took the engine, wouldn't you?

A. You would always carry it with you when you steered the engine, if that makes any difference.

Q. That is what I am driving at. When you steer you move the outlet so it will always be in the plane of the propeller?

A. That was never in my mind. That is the first time that thought has occurred to me. That was not my intention.

Q. The words are in the claim.

A. They were not intended that way.

Q. Now in the device shown in your patent, when you turned the motor to steer the outlet would turn too, wouldn't it, so it would always be directed squarely into or
141 along the direction of the slip-stream?

A. It would be in the direction of the slip-stream of the propeller.

Q. Yes, of the propeller, I mean.

A. Yes.

Q. Now in defendant's 16 horse power motor, as shown in Plaintiff's Exhibit 8, would you say that the outlet tube was always directed in the direction of the slip-stream of the propeller?

A. No, that particular outlet does not move with the steering movement.

Q. Mr. Irgens, referring to Johnson patent No. 2,067,533, that is the spark plug cover patent, you testified in your

direct examination that cover served the purpose of keeping spray off the spark plug?

A. Yes.

Q. Are you familiar with electrical conduit boxes and switches that are weather-proofed for outdoor use?

A. Yes.

Q. Do you know how the weather is kept out of the parts that are to be protected?

A. In a case like that you put a gasket on and bolt the parts together.

Q. Have you ever seen any outlet boxes with a
142 hinged cover?

A. I have seen outlet boxes, but whether they have been for outdoor use or not I would not be able to tell you now, with a hinged cover.

Q. If you had an exposed part that you wanted to protect from water or dirt, how would you protect it?

A. You would cover it up.

Q. And if that exposed part projected from a larger body, how would you fasten the cover to that body if you wanted to have access to that part?

A. You would make it so you could readily open it.

Q. Would you hinge it on to the body if it were more convenient?

A. That would be a very convenient way of doing it; yes.

Q. Was that hinging and covering idea suggested to you by the Johnson patent No. 2,067,533?

A. Suggested to me?

Q. Yes.

A. In connection with what?

Q. With your last two answers, where you said you would hinge a cover on as the obvious way to protect something that was exposed.

A. No. I think that is the common way of closing
143 anything.

Mr. Rummler: That is all.

Redirect Examination by Mr. Wheeler.

Q. With reference to the Evinrude patent in suit No. 1,786,835, you were asked about the opening through which the drive shaft passes, and I would like to ask you to refer to Plaintiff's Exhibit 8, and state what would be the effect of the omission of the bearing above the pump chamber,

so far as water following up the drive shaft is concerned. In other words, would the omission of that bearing enable the water to pass upwardly along the drive shaft?

A. If the pump impeller is relatively close to the upper surface of the pump chamber, then that bearing is not necessary to seal.

Q. Will you refer to Plaintiff's Exhibit 8, and state whether that bearing is located at or above the level of the impeller?

A. The bearing is located above the level of the impeller.

Q. What is between the impeller plate surface and the bearing in this defendant's construction, as shown in
144 Plaintiff's Exhibit 8?

A. There is a space and then the hub of the impeller is in that space.

Q. That space surrounds the hub and is above the impeller?

A. That is correct.

Q. Does that space represent an opening between the propeller shaft and that portion of the wall of the pump chamber nearest to which the impeller operates?

A. Yes.

Q. Is it true of both the patented construction, as shown in patent No. 1,786,835, Figure 3, and the defendant's construction as shown, for example, in Plaintiff's Exhibit 8 and Plaintiff's Exhibit 5, that in each instance the lower bearing for the drive shaft runs part way up the drive shaft from the gear casing to the inlet of the pump chamber?

A. That is correct.

Q. That is true in the patent and in both of defendant's constructions?

A. Yes.

Q. In each instance does the water as it approaches the pump chamber completely surround the drive shaft?

A. Yes.

145 Q. With respect to your own patent No. 1,869,749, on the tapered exhaust pipe, if you had a stationary engine located at the water's edge, for example, to operate a pump, and if you extended the exhaust pipe from the stationary engine into the water in order to suppress the noise of gas issuing therefrom, such an exhaust pipe would not move in accordance with the operation of the engine, would it?

A. No.

Mr. Wheeler: That is all.

Mr. Rummler: That is all.

The Court: We will take a short recess, gentlemen.

(A short recess was taken.)

Mr. Wheeler: Your Honor, we are resting our case, with the understanding that defendant's Exhibit H, showing the spark plug cover, is later to be offered in behalf of the defense.

Mr. Rummler: I will offer it now, Mr. Wheeler, if you wish.

Mr. Wheeler: All right.

Mr. Rummler: We will offer in evidence as Defendant's Exhibit H a motor head for the 9-horse power
146 motor manufactured by defendant and showing the spark plug cover used by defendant attached.

The Court: Very well. It may be admitted.

(The exhibit was so marked.)

Mr. Wheeler: We rest.

Plaintiffs Rest.

Thereupon the defendants, to maintain the issues on their behalf, introduced the following evidence, to wit:

147 CLESENT O. FIELDS, called as a witness on behalf of the defendants, having been first duly sworn, testified as follows:

Direct Examination by Mr. Rummler.

Q. Please state your name, residence, age and occupation.

A. My name is Clesent O. Fields; my residence is Route 1, Gaston, Indiana. This is adjacent Muncie, Indiana. My occupation is chief engineer of Muncie Gear Works, Incorporated.

Q. How long have you been chief engineer of Muncie Gear Works, Incorporated?

A. That employment as chief engineer started somewhere approximately five years ago.

Q. What has been your technical training and experience, Mr. Fields?

A. I have as a background an I. C. S. course of engineering, which was completed, and as a basis for that I had a draftsman's course in high school. From there

I went directly into the Muncie Gear Works in 1917, and I have been with them, with the exception of five
years of that time. I have studied also a business
148 administrative course and a radio course, which
has aided considerably in our work.

Q. Mr. Fields, have you participated in the designing of the Muncie motors, as shown in Plaintiff's Exhibits 5 and 8?

A. Yes, sir.

Q. What was the extent of that participation?

A. The 16-horse power motor was developed early, before I became chief engineer, but at that time I was assistant engineer of the company and I had full responsibility of the layout and design from the standpoint of checking and functioning. The 9-horse power motor was entirely designed and developed under me as chief engineer.

Q. Mr. Fields, can you tell by giving dimensions what the shape of the housing, the under-water housing of the 9-horse power motor, shown in Plaintiff's Exhibit 5, is?

A. Yes, I have those prints with me. I can give those accurate dimensions.

Q. To what prints do you refer, Mr. Fields?

A. I have prints of our housing which encloses the gears of both motors and the housing above the anti-
cavitation plate of each of the motors which en-
149 closes the impeller.

Q. Are those prints of the Muncie Gear Works, showing the actual construction of these motors?

A. They are detailed prints from which the patterns have been made and from which we machined our parts.

Q. Do you have those prints with you, Mr. Fields?

A. I have one set here in my own folder.

Q. Referring to the drawings relative to the 9-horse power motor, please tell what the shape of the lower stem adapter or that portion of the housing above the anti-cavitation plate is in the 9-horse power motor.

A. That section has a front apex, a radius of three-sixteenths of an inch and at the rear of that section—

The Court: What are you talking about?

Mr. Rummler: The shape of the section of the upper—It is called the lower stem adapter, your Honor, it is the upper part of the housing, that portion above the anti-cavitation plate.

Go ahead, Mr. Fields.

A. The leading edge is three-sixteenths of an inch, while the trailing edge is a blunt-like end, with a depressed radius for the water line to nest in, entirely different from the front leading edge.

Q. What is the radius of the blunt trailing edge?

150 A. There is no radius given for the blunt trailing edge. It has two edges on the outside of these tube recess plates, it has a five-sixty-fourths radius. There is no definite single edge with a radius on.

Q. Then the leading edge of that lower stem adapter is considerably more sharp than the trailing edge, is it not?

A. Definitely so.

Q. Referring to the lower unit, Mr. Fields, what is the shape of the section both above the water inlet openings and at the water inlet openings?

A. Above the water inlet openings is a leading edge of three-sixteenths of an inch radius. At the water inlet openings we have a one-eighth inch rib for its full length, which extends back three-eighths of an inch from this edge, at which point it flares out at a fifteen degree angle until it meets the side walls as they come in on their surface, which is tangent to the three-sixteenths radius above.

Q. Mr. Fields, is the water inlet area rounded or flat?

A. The water inlet area is definitely round—I mean flat.

Q. It is perfectly flat?

A. Definitely flat.

151 Q. Mr. Fields, what is the shape of the trailing edge of this lower housing section?

A. The trailing edge of this lower section is a larger radius. That radius is not given on the print. It is a radius which is drawn a distance of one and seven-eighths inches back from center line to meet the contour of the sides, and it has approximately five-eighths of an inch radius.

Q. Is the trailing edge more blunt than the leading edge of the under-water section, that is, the lower unit of the 9-horse power motor?

A. Definitely so.

Q. Mr. Fields, do you have anything with you to show the dimensions of the 16-horse power motor?

A. Yes, sir; I have the prints of both housings of that motor.

Q. Mr. Fields, will you describe the shape of the lower stem adapter or that portion above the anti-cavitation plate in the 16-horse power motor, as shown in Plaintiff's Exhibit 8?

A. That housing, regarding the front and rearward edge, is definitely knife-edged and has a one-sixteenth inch radius at both ends.

Q. What is the shape of the lower gear casing?

152 The Court: What are you talking about now?

Mr. Rummler: We were talking about the upper portion above the anti-cavitation plate.

The Court: I thought you said the lower. What were you talking about first?

Mr. Rummler: The lower stem adapter is—

The Court: What is that?

Mr. Rummler: That is this part above the anti-cavitation plate.

The Court: Oh, I see.

Read the question.

(The question was read as follows: "What is the shape of the lower gear casing?")

The Court: What are you talking about now?

Mr. Rummler: That is the portion below the anti-cavitation plate, or that portion which includes the anti-cavitation plate.

The Witness: He has changed to the lower one.

The Court: I cannot go ahead on this thing until I know what you are talking about.

Mr. Rummler: Mr. Fields, will you describe the shape of the housing above the anti-cavitation plate, and refer to this Plaintiff's Exhibit 8, as well as the drawings which you have.

153 A. Referring to Plaintiff's Exhibit 8, the section is shown as the top section of these four, which show the contour of the housing, and referring to our print OB17-52A, to the upper view, you will see this section is definitely sharp at both front and rearward sides and has on both ends a one-sixteenth radius.

The Court: Now where do you see that here? I see it there (indicating), but where do you see it here?

A. That is taken as a separate view down upon that section and we have a rib overlying that section. These are shown by dotted lines, the contour we are speaking of.

The Court: In here (indicating)?

A. That is the upper view I am speaking of. You can see it in the lower view also. It is dotted there. It has a radius of seven and five-eights, as shown in the lower view. That is the side radius which forms the contour. Then at each end there is a one-sixteenth radius which forms the ends.

Mr. Rummler: Does the Court find that?

The Court: I don't know. Go ahead.

Mr. Rummler: Q. Mr. Fields, will you hold up the drawing that you are referring to and point to these parts that you are talking about?

154 A. This contour through here, which is the one that enters into the claim of stream line, is shown by these dotted lines at this point right here, and this one here (indicating), and it has a radius of seven and five-eighths on the side, with a one-sixteenth radius out at the end, at each end.

The Court: Now what is it that tells you where that cross-section is taken?

A. It is not a cross-section, your Honor. It is a view, and here is the reason why it is dotted. You have this rib above it and it is shown directly below that.

The Court: I know, but what shows where that comes from?

A. Your width at that point there is such that if it projected up here it would bring that directly in line with that. It could not be any other section but that.

The Court: The width down here (indicating)?

A. Yes, that is right.

Mr. Rummler: Q. Now, Mr. Fields, referring to the gear housing, or that part including the anti-cavitation plate, what are the dimensions and shape of that?

A. That shape is shown on Plaintiff's Exhibit 8 as in the two lower sections and as shown on our drawing. That
155 section is exactly six inches long and each end is a one-sixteenth radius. In other words, there is a sharp point at the front and a sharp trailing edge.

The Court: You gentlemen may be trying this for the Circuit Court of Appeals, but just do me the favor to try it for me and make me understand it.

Mr. Rummler: That is right.

The Court: You evidently don't care whether I understand it or not.

Mr. Rummler: I do, your Honor.

I have here a device marked for identification as Defendant's Exhibit E.

Q. Mr. Fields, will you please state what that is.

A. This is our lower gear housing as shown on our print OB16-90. This is the lower member.

Q. That is the gear housing for what motor?

A. The 16-horse power motor.

Q. Will you please point out to the Court the dimensions that you are speaking about, and the shape of the unit, and then hand it to the Court.

A. All right, sir. On this point our print calls for a one-sixteenth inch radius and the same on this end which gives that a sharp leading edge and a sharp trailing edge.

156 The Court: Let's see that.

(The article was handed to the Court.)

Mr. Rummler: That is the trailing edge, your Honor (indicating).

The Court: Is that a one-sixteenth radius?

A. As given on our prints. It casts probably a little dull and it might run a little larger than one-sixteenth, but not much.

The Court: At both ends?

A. Yes, sir.

Mr. Rummler: Your Honor, the reason we are going into the shape of these under-water parts is because it is—

The Court: My dear sir, I do not object to your going into anything if you will just see to it that I get an opportunity to understand it as you go along. I do not object to your going into anything and everything if you will just try to make me understand as you go along.

Mr. Rummler: All right. I will try to do that.

Q. Mr. Fields, I hand you a device marked for identification as Defendant's Exhibit F, and ask that you state what it is.

(The device was so marked.)

A. This is the housing that encloses the impeller of
157 an outboard motor and set just above the anti-cativation plate. It has this broad housing at the base, while at the top above it we have a leading sharp edge and a trailing sharp edge.

Q. Mr. Fields, will you hand that exhibit to the Court and point out where that part goes on this drawing, Plaintiff's Exhibit 8?

A. That part on Plaintiff's Exhibit 8 sets here between the anti-cavitation plate and the stem which fastens to it.

Q. Mr. Fields, I hand you a device marked for identification as Defendant's Exhibit D, and ask that you tell what it is..

(The device was so marked.)

A. This is the gear housing on our 9-horse power motor, and as shown on Plaintiff's Exhibit 5, is one in which we have a three-sixteenths radius at the front and a one-eighth inch rib on the inlet portion of it. At the rear we have a radius which approximates five-eighths of an inch. That radius is not given on our drawing, but is a tangential radius struck over the radius that is given on the sides and is set out so far from center back to this point.

Q. Mr. Fields, I hand you a device marked for iden-
158 tification as Defendant's Exhibit C, and ask you to tell what it is.

(The device was so marked.)

A. This entire unit is the upper portion of the stem of the 9-horse power outboard motor. At the lower end of this we have our impeller housing which forms the upper portion of the drive shaft housing and also encloses the impeller. We have on it a leading edge of three-sixteenths of an inch radius. At the rear of it we have a trailing edge which is blunt, with a depressed recess in it for carrying our water line.

Q. Referring to Plaintiff's Exhibit 5, will you please point out on that drawing where that unit you are holding goes?

A. The lower portion, which is an aluminum housing, starts here (indicating), which is just above the anti-cavitation plate, and ends up in the brass stem at a point here (indicating). The entire unit starts here and ends up adjacent to the motor.

Q. That is, the entire unit you are holding in your hand, marked Defendant's Exhibit C?

A. Yes, sir.

Q. How is the motor of the 9-horse power unit and the 16-horse power unit mounted with respect to the stem,
159 which is that portion you have in your hand?

A. The motor is mounted to a housing, which housing is fastened to the stern bracket or clamp that fastens it to the boat, and is stationary. This shaft, that is, this housing here I am speaking of, that housing there is fastened to the motor at this point (indicating), and in turn

the stern bracket is pivoted at this point. Then the stem is loosely journaled in that housing for steering. It is not in any way fixedly connected to the motor. The motor head is stationary during the steering of the motor.

Q. And the only part that moves is what?

A. The only part that moves is the stem and the gear casing to which these parts are attached.

Q. In Defendant's Exhibit C that you have in your hand, where is the tiller handle attached?

A. The tiller handle is attached at this point (indicating).

Q. Is there any fixed connection between the turning brass shaft and the motor, that is, this quill or stem that carries the under-water parts?

A. There is no connection other than loose connections, turnable connections.

Q. And the turning of the brass stem in no way
160 affects the position of the motor, does it?

A. It does not.

Q. Mr. Fields, referring to Plaintiff's Exhibits 8 and 5, where would you say the normal water line would be?

A. The normal water line is not describable in these units, because that is entirely according to the boat that it is on. We have found in our practice that the proper place to locate the anti-cavitation plate is in line with the bottom of the boat, possibly about a half-inch below it, and then it depends entirely on how far that boat sinks in the water where that line would come.

Q. So it cannot definitely be stated?

A. There is no particular place you could point to and say, "That is the water line."

The Court: I assume that would be above the propeller and that would be below the engine.

A. You are correct in that.

Mr. Rummler: Q. And it often might be well above this casing portion?

A. It is often above that casing portion.

Q. In both the 16-horse power and the 9-horse power motors?

160½ A. That is right.

Q. Mr. Fields, what is the effect of the gear casing, that is, the pump impeller housing, on the stream lined action of these motors when they are in use?

A. It is definitely detrimental to stream line action.

The Court: What is that?

(The answer was read.)

Mr. Rummler: It is this pump line, your Honor, this bulge.

Q. In what way is it detrimental?

A. It forms a resistance to the water, that is, the relative closeness of the water in different positions of the boat will throw up what we call "rooster tails." There is a stream of water that goes off that and flies free in the air, free from the water.

If the motor is submerged deep enough, you still have the parting of the water, which shows there is a definite resistance to the movement of the motor through the water.

Q. Does that parting of the water ever bare the anti-cavitation plate so that air could reach is upper surface?

161 A. It does.

The Court: We will recess at this time until 2:00 o'clock.

Whereupon a recess was taken until 2:00 o'clock p. m. of the same day.

161½ Monday, January 29, 1940
2:00 o'clock p. m.

Court convened pursuant to recess.

Present:

Messrs. Rummler, Wheeler, Wilkinson.

CLESENT O. FIELDS resumed the stand for further direct examination by Mr. Rummler.

Q. Mr. Fields, referring to the Evinrude patent No. 1,786,835, how is the motor of that device shown in Figure 3 mounted on the stem?

A. That unit is mounted as an integral unit, the stem and motor fastened together.

Q. Does the motor turn when the stem turns for steering?

A. It does.

Q. Is the motor mounted on the stem?

A. It is.

Q. The stem being that portion numbered 16?

A. Yes, sir.

Q. Mr. Fields, referring to Plaintiff's Exhibits 8 and 5, showing the defendant's 16-horse power and
162 9-horse power motors respectively, how do those devices steer?

A. Those devices steer by the use of this steering lever attached to the top casting which is pressed into the stem and is fastened there with screws. It in turn is turnable in the housing that is fastened to the stern bracket, but this housing is fastened to the motor, with the stem free and turnable between the two units.

Q. How is the steering effect brought about?

A. The steering effect is brought about by turning the stem only with the steering lever, while the motor remains stationary.

Q. Is there any rudder effect from the under-water portion of the shaft housing?

A. We find very little in actual practice. Your slip-stream is your actual steering means during operation of the motor and immediately after shutting off the motor your boat will stop, within a very short distance, and by very short distance, usually that is three or four feet at the maximum.

Q. During the period that the boat is stopping, what steering effect do you have from the housing?

A. It is so slight it is hardly noticeable.

163 Q. Mr. Fields, you have operated these motors on a boat in the lake, haven't you?

A. I have.

Q. Will you describe what happens when you turn off the motor while the boat is under way?

A. When you turn off the motor while the boat is under way, the resistance that the water creates against the boat immediately brings that boat to a stop. In some instances, if your boat is heavily laden with its load, the water will even come over the rear end of the boat, it stops so quick.

Q. What control do you have over the boat during this stopping period, while the boat is slowing down after the motor has been shut off?

A. There is practically no control over the boat during that period. It is so slight that any light wind will vary you off the course that you have been carrying before your motor stops.

Q. Then do you or do you not get an effect of rud-

der from this under-water casing after the motor has been shut off?

A. In the case of our motors, no wider than their stems are, we have noticed very little effect.

Q. What is the effect, if any, that the propeller
164 has on steering after the motor is shut off?

A. It has a definite drag on the steering. It can affect it some, depending entirely on where the blade was.

Q. Just what do you mean by that, Mr. Fields?

A. The blade of the propeller will stop according to wherever the motor ceases its function, and that might hanging out equally on both sides, might be hanging on one side, or any position around, and naturally that drag would have its effect if it is uneven.

Q. What would be the effect of the drag if the propeller stayed in an uneven or unbalanced position?

A. It would tend to, the drag, of course, is to retard the movement of the boat, and therefore if your drag is uneven in its relation to the stem,—it would tend to turn the boat on the side which is turning the heavier.

Q. It would turn the boat to that side?

A. Yes.

Q. Would the casing itself be of sufficient area to counteract that turning effect caused by the unbalanced propeller?

A. As stated before in our case our casings are so narrow it has very little effect.

165 Q. Referring to Irgens patent No. 1,869,749, on the exhaust tube, have you conducted any tests on the exhaust tube shown in Plaintiff's Exhibit 8?

A. I have.

Q. As to its resonance, and whether or not it will destroy resonance?

A. We have made some tests just recently on that, and our experience was that we could eliminate the taper and still get equal results.

Q. Mr. Fields, why did you adopt the tapered form for that tube?

A. We adopted that from an appearance standpoint and then after testing it proved that it was satisfactory and therefore the design was adopted as originally laid out.

Q. Do you have any resonance in the tapered tube

that you use, that is, resonance as Mr. Irgens has explained it?

A. We have not tested resonance in the tapered tube. We have tested it in the manifolds above the tapered tube.

Q. Does your tapered tube produce any back pressure?

A. Yes; we have some back pressure in our unit.

Q. What were the results of those tests you say
166 you made and what were you testing for?

A. We were testing for resonance in the muffler drum, which is the top of the muffler, the top of the T formed by the muffler, and resonance in the manifolds, which are the castings leading from the exhaust ports to the end of the T of the muffler.

Q. Mr. Fields, I hand you a device marked for identification as Defendant's Exhibit G. Will you, using that device, point out the elements that you are talking about.

(The device was so marked.)

A. We were testing for resonance in this muffler drum or shell at the top of the taper and for resonance in the manifold or casting leading from the exhaust port to each end of the muffler shell.

Q. What were the results of those tests?

A. Our tests showed that there was no resonance in those particular parts.

Q. Just how did you conduct those tests?

A. Those tests were made on a motor in a tank and the detail of the test was that we first took a standard muffler, as you see it here, with the taper open, and we run that motor wide open at the maximum speed we could obtain from that motor. We also checked
167 performance at low speed, that is, idling, to see
what the characteristics were at both ends of the scale. Then, after running that, we took the muffler in which we had blocked off this top opening here with a shield and drawn it down tight so that no gases or pulsations could get down in the taper. We then took the drum cover off and exhausted out at that point.

Q. Through that opening you just mentioned?

A. Through this opening here. Then we changed that noise level. We then took the exhaust manifolds entirely from the motor, which left the exhaust ports exhausting directly out.

Q. To atmosphere?

A. To atmosphere. The noise level was materially higher, exhausting directly into atmosphere than it was exhausting at this port opening in the back, than it was with the exhaust ports open.

That test in itself proved that there was not resonance in the manifold muffler shell and the other manifolds coming in from the other side.

Mr. Rummler: Speak a little louder.

A. There was no more resonance coming from the manifold leading into the muffler shell than there was in the other side. In other words, there was no in-
168 crease in the noise level.

Q. How did that compare with the tube in normal operation with that downwardly extending part wide open.

A. With it wide open, with your ports wide open, we had r. p. m.'s at 3800 and 3900, and with the back exhaust port open it was 3600 to 3700. Both tests were with the same motor and our attendant obtaining the maximum from the motor. In other words, it showed a slight restriction in this manifolding around here with that open.

In our next test on that we put a one and a half inch round tube in this place and sealed off around the inch and a half tube.

Q. That is, at the muffler?

A. Yes, and sealed this so that no exhaust pulsations could get into the housing around the inch and a half tube. Then we tested that and we obtained the same number of r. p. m.'s, 3600 to 3700, as we did with the standard muffler, and our idling was still good and our noise level was much less than with the taper wide open.

Q. Then from those tests you would conclude that the perfectly round untapered exhaust pipe would give
169 better results with that engine than the tapered exhaust pipe; is that so?

A. These tests certainly indicated that.

We also tested that with a plain shell perforated, without any extension whatever, and served in the place of this entire unit, and that shell also gave us the same number of r. p. m.'s, but with a little higher noise level than what the inch and a half tube gave us, but a little better, a little less noise level than what this was.

If the Court wishes to see those exhibits it might give him a better picture of it.

Q. Is this the one that you are referring to?

A. That is one with the inch and a half tube in it and sealed off.

Q. Will you explain how that inch and a half tube is set in there?

A. As explained, the muffler was cut off at this point, this inch and a half tube extending into it.

Q. That point is where, with reference to the end of the exhaust tube?

A. Slightly above the lower portion of the taper at a point large enough to get the inch and a half tube in.

Q. Where does that taper end, normally?

170 A. That tube ends normally at this point here (indicating).

Q. That is how far between the ends of the taper, how far down from the top does the taper end?

A. The taper ends approximately, I would say, nine inches down from the top.

Q. How long is the over-all length of the tube?

A. The over-all length of this inch and a half tube or casting?

Q. The whole exhaust tube.

A. The whole exhaust tube is approximately two feet long.

Q. Then the taper terminates just above the half-way distance between the ends; is that correct?

A. That is right.

Q. Please go on with your explanation of that.

A. This unit, as you notice, is sealed on the inside around the inch and a half tube, still below, and is held from moving by these screws. The back plate was left on that as you see it.

Q. Then that gave you the effect of a perfectly round tube coming directly down from the expansion chamber at the top, that is the T-shaped portions, without any taper in it, let us say?

171 Mr. Wheeler: Objected to as leading, your Honor.

The Court: Well, let him answer.

A. Yes, sir.

Mr. Rummler: That will be all, Mr. Fields.

Mr. Wheeler, you may have the witness for cross-examination.

Cross-Examination by Mr. Wheeler.

Q. Were you under the impression that the matter of pressure resonance as testified to by Mr. Irgens, could be gauged by whether there was a change in sound level?

A. Yes, sir; I was.

Q. Did you make any tests to determine whether there was a frequency at which you were getting a repetitive pressure zone at the top of that exhaust tube?

A. We made the tests at 4,000 r. p. m., approximately 4,000. We were 200 under that.

Q. What test did you make, the one you just described?

A. The one I just described.

Q. You made no tests with any instrument that would have shown you whether you were getting a pressure zone repeated periodically at that point, the top of the tube?

172 A. The only instrument we used was a tachometer which showed the speed of the motor.

Q. You made no tests as to pressures?

A. We made no tests as to pressures.

Q. Now then, a few moments ago you said that the tube when sealed in gave you the effect of a straight tube instead of a tapered tube; is that correct?

A. Yes, sir.

Q. But when you put that tube in there you changed the volume of your whole muffler system, did you not?

A. That is correct.

Q. So that in that sense you did not get the same comparative situation. You had a different volume to deal with, did you not?

A. That is correct.

Q. You said that that muffler system was approximately two feet long. Were you referring to the muffler and the exhaust tube in a single casting as you have produced it here?

A. That is right.

Q. What is the diameter of the muffler proper, the expansion chamber at the upper end of that casting?

A. About five by nine, five inches diameter by nine inches long.

173 So that the total length of the tube itself is about nineteen inches?

A. That is correct.

Q. How long has the defendant used this tapered exhaust pipe?

A. This particular unit was brought out when the motor was designed.

Q. When was that?

A. I don't know definitely. I was there, but I cannot remember the date exactly, but I believe though around '31, It may be a little earlier.

Q. For a number of years you have been familiar with the fact that the plaintiff has been protesting about the defendant's use of that tapered exhaust pipe?

A. Yes, sir.

Q. What led you to feel that that pipe was an advantage from an appearance standpoint? Were you familiar with the appearance of the motors made by Mr. Irgens' company in which that tapered exhaust pipe was used?

A. Not at the time it was designed. That muffler was brought into our shop at a later date to show us what similar competitors were doing, and we discarded it for the one we have now, for appearance' sake.

174 Q. How much does it cost you to make tapered exhaust pipes more than it would cost you to use an ordinary straight pipe in that same location?

A. That casting there is much more expensive than a sheet metal muffler would be.

Q. Approximately how much more expensive?

A. It depends on the metal you use in it. If you were using stainless steel, it would tie in at about the same cost.

Q. You said you made a pipe for testing purposes. Did you use stainless steel in that?

A. No, sir.

Q. Using a straight tube?

A. No, sir, but that was not offered to the public, of course.

Q. Well, considering that only as a standard, how much more does it cost you to make this unit as actually used on defendant's motors than an ordinary piece of straight pipe would cost?

A. It would cost approximately three times the cost of a straight pipe to make it as defendant's motor shows it, or not the defendant, but Evinrude's motor.

Q. Defendant's motor, your motor?

A. Our motor. More than a straight pipe, it
175 would cost approximately three times as much as a straight pipe would.

Q. I believe you testified that you had been chief engineer for defendant for approximately five years?

A. That is correct.

Q. And that you had been in the employ of Muncie Gear Works since 1917, with the exception of five years?

A. That is correct.

Q. What was the period during which you were not employed by the defendant?

A. I was away from Muncie Gear Works from 1918 up to '21, and then during the receivership of the old company.

Q. When did you take this correspondence school course in engineering, about what time?

A. In 1917.

Q. When did Muncie Gear Works enter the outboard motor business?

A. 1929 or 1930, as I remember it.

Q. Were you then assistant engineer?

A. Yes, sir.

Q. I believe you testified that the water inlet area was flat in the 9-horse power motor, Plaintiff's Exhibit 17?

176 A. That is correct.

Q. But a little later you testified, I believe, that the surfaces in which that row of inlet ports was formed were at about fifteen degrees to the horizontal?

A. A flat surface, yes, at fifteen degrees.

Q. Then the total water inlet, considering both surfaces, included surfaces that are at thirty degrees to each other; is that correct?

A. That is correct.

Q. So they are not flat, but are two surfaces that have a thirty-degree angle between them?

A. That is correct.

Q. Will you please take this motor, Plaintiff's Exhibit 17, which is defendant's 9-horse power model and which is mounted on a stand, and will you please move the lower unit forward and back as that motor is supported on the stand.

A. You mean as pivoted?

Q. Yes.

A. That is forward and back.

Mr. Wheeler: The witness has taken hold of the power head and moved the entire unit forward and back.

Q. Now will you please do the same thing, taking hold at the lower unit.

177 A. (Witness does as requested.)

Q. When you moved the lower unit forward and back, the entire outboard motor pivoted about the horizontal pintle that connects it with the transom bracket, did it not?

A. It did.

Q. So when you move the lower unit the power head also moves?

A. Yes, on that type of pivot.

Q. If you were to remove that pintle which holds the motor structure to the transom bracket, you could take hold of the lower unit and lift the entire motor, could you not?

A. That is correct.

Q. When that motor is in operation a considerable thrust is exerted forwardly at the propeller?

A. That is correct.

Q. And that thrust tends to oscillate the entire motor as a unit about that pintle that connects he motor with the transom bracket, does it not?

A. Yes, sir.

Q. What keeps that motor in an upright position?

A. That motor is kept in an upright position by its location on the thrust socket and the pivot and in its
178 relation with the stern bracket and stern of the boat.

Q. Will you please tilt the motor and point out to the Court the thrust bearing against which the motor presses?

A. The thrust bearing is fastened to the stern bracket and the stem as it comes down bears against that.

Q. So it is the contact of the shaft housing or stem with that thrust bearing that holds the motor upright?

A. That is correct.

Q. And but for that shaft housing being in contact with the thrust bearing the motor would continue to tilt farther and farther under the pintle, under the thrust of the propeller; wouldn't it?

A. Until it met something that stopped it.

Q. Yes. So that in order to hold the power head in a horizontal position, you depend on the pressure con-

tact of the shaft housing or stem with the bracket or some other stationary part; is that correct?

A. That is correct in its thrust direction.

Q. If the stem were removed completely from the crank case, the whole power head would fall downwardly to the horizontal pintle which connects it with the transom bracket, wouldn't it?

A. That is true, of course, provided this pintle was
179 left as loose as it is now. It can be clamped.

Q. But in practice it has to be loose enough so the motor will tilt when it encounters a submerged obstruction?

A. That is correct.

Q. Who designed the lower units of the defendant's motors?

A. The 16-horse power was under the supervision of William W. Peck, as chief engineer at the time the 16-horse power motor was designed. The 9-horse power was designed under my own supervision.

Q. In designing the lower unit for the 9-horse power motor, what considerations determined how far upwardly you would extend the stream lining above the anti-cavitation plate?

A. Various things have contributed to that. We originally, on one of our early motors, had an impeller housing set at this point.

The Court: Speak a little louder so I can hear.

A. We originally, on an early motor, had an impeller housing set at this point. It was stream lined below the impeller housing, but not above. These units are stream lined to gauge the normal position for high speed work.

180 Mr. Wheeler: Q. In other words, under normal operating conditions the water line would fall within the portion of the lower unit that you have stream lined?

A. The top of the water, yes, should for best propulsion fall in the rear.

Q. It does ordinarily, in fact, does it not?

A. I couldn't say that over fifty per cent of it did.

Q. Then why don't you extend your stream lining farther up the shaft housing?

A. For the simple reason that in the other operation when it does not fall within that area no efficiency could be obtained, whether it was above or below it.

Q. Then when it is operated in accordance with your intent, the intent for which it is designed, the normal water level is within the stream lined portion?

A. That is correct?

Q. You stated that the effect of the pump impeller housing was detrimental to the operation of the device. Was it sufficiently detrimental so you had to compensate by the use of a larger anti-cavitation plate than you would otherwise have used?

A. Yes, we have. We started out with a smaller anti-cavitation plate on the 16-horse power than what we have there now.

181 Q. And you added increased area to that anti-cavitation plate to harmonize it with the design that you are actually employing for the upper end of the shaft housing?

A. That is correct.

Q. For what purpose do you sharpen the front and rear ends of the enlargment in which the pump impeller is located?

A. We do that to break as much of the force as we can.

Q. To make it move through the water with little resistance?

A. With as little resistance as we can.

Q. And with less spray?

A. That is correct.

Q, You say that you personally have for some time operated outboard motors?

A. That is correct.

Q. On what kind of boats, planing boats or displacement boats?

A. Both types.

Q. Does it not make a difference whether your boat speed drops immediately whether you are using a planing boat or a displacement boat?

A. It does.

182 Q. Your displacement boat will continue to operate through the water without stopping as abruptly in proportion to a planing boat, will it not?

A. That depends on the position of that boat. If you had a single passenger who was sitting in the rear of this boat and you had a considerable wall of water in front, it would stop much quicker than it would with two in there.

Q. How far from the dock do you stop your motor when you are approaching the dock?

A. Not over six feet.

Q. Supposing you were running your motor at top speed, how far away from the dock would you stop the motor?

A. It should stop, I would say, to be safe, within twenty feet. You may have to row in or start your motor again.

Q. Have you, in approaching a dock, ever used the propeller handle for steering after having cut off the motor?

A. I have tried it.

Q. Don't you do it regularly?

A. No, sir.

Q. You don't do that?

A. No.

183 Q. Don't most people?

A. I have not observed them to do that.

The Court: How is that?

A. I have not observed that.

The Court: To do what?

Mr. Wheeler: Use the tiller for steering after the power has been cut off.

Q. What difference, if any, is there, between your 9-horse power and your 16-horse power, from the standard of your ability to steer after the power has been cut off?

A. I have not noticed that carefully enough on that unit to tell.

Mr. Wheeler: That is all.

Mr. Rummler: I would like to ask just a few more questions.

Redirect Examination by Mr. Rummler.

Q. Was the tapered exhaust tube used on the 16-horse power motor designed to produce any particular result?

A. None other than appearance and to accomplish sufficient muffling to satisfy the customer.

Q. In cross-examination, Mr. Fields, you mentioned
184 the angle of the surfaces of the water inlet and I believe you said that the angle between those surfaces was thirty degrees. Will you examine this unit, Defendant's Exhibit E, which is the skeg or lower housing of a No. 16 motor, and tell me if the angle between those inlet surfaces is thirty degrees.

A. I find I made an error in my statement, and that the angle between the two surfaces is thirty degrees from one hundred twenty degrees, which is a total of ninety degrees.

No. Excuse me. Thirty from a hundred and eighty. That is still a hundred and fifty degrees.

Q. And those surfaces slant backwards so that the fifteen degree angle is relative to what?

A. The fifteen degree angle is relative to a perfect flat across the front, fifteen degrees off of a perfect flat from the front.

Q. In what direction?

A. That flat is at right angles to the axis of travel.

Q. In what direction do these surfaces slant fifteen degrees off from the direction of travel?

A. They slant, let us put it in terms directly in proportion to the travel, it is fifteen from ninety, and that would be seventy-five degrees from your direction of travel.

185 Q. Then the angle between these inclined inlet surfaces would be what?

A. The angle between—

Q. That is, the included angle between the inlet surfaces?

A. The included angle would be one hundred fifty degrees.

The Court: What angle are you talking about?

A. This angle on this base of that flat portion, where those holes are drilled. It is not a flat surface; it is angled off.

The Court: What hundred and fifty degree angle are you talking about?

A: The angle from this face around to the other face on the other side, the included angle between those two pieces.

The Court: I see.

Mr. Rummler: Maybe you can illustrate that with your hands, Mr. Fields.

A. Speaking of the included angle which slopes down fifteen degrees off of the perfect flat across here.

Q. The plane normal to the fore and aft axis.

A. That is fifteen degrees away from your plane flat which you would have.

186 The Court: What are you trying to find, the angle at which the two planes would meet each other, if they did meet?

Mr. Rummler: That is right. On cross-examination he said the angle between the two planes was thirty degrees and I just wanted to correct that for the record.

The Court: Well, it just depends on what angle it is.

Mr. Rummler: The included angle between the two surfaces. The two surfaces meet like I have my hand.

The Court: It just depends on the angle he means.
Mr. Rummler: That is all.
Mr. Wheeler: That is all.
Mr. Rummler: At this time I would like to introduce as DEFENDANT'S EXHIBIT A a bound volume of the prior art relied upon by the defendants. Thus book includes the patents arranged in chronological order, that is, first the United States patents relied upon, and then the foreign patents relied upon, and lastly, the publications relied upon.
The Court: It may be admitted.
(The exhibit was so marked.)

187 EUGENE A. RUMMLER, called as a witness on behalf of the defendants, having been first duly sworn, testified as follows:

Direct Examination by Mr. Rummler.

Q. Please state your name, residence, age and occupation.
A. Eugene A. Rummler, 1015 Star Road, Winnetka, Illinois; my business is patent attorney.
Q. Mr. Rummler, how long have you been engaged in the practice of law?
A. Forty years next March.
Q. What are your qualifications which, in your judgment, qualify you as a mechanical and patent expert in this case?
A. I graduated as a mechanical engineer at the University of Michigan in 1898. I had been employed for six years by the Detroit Water Works, in the engineering department, that is at Detroit, Michigan, and participated in the conducting of a large series of experiments to determine the flow of water in pipes.
I was employed for one year in the drafting room of the Detroit Dry Dock Company, under Frank E. Kirby,
188 a Naval architect.
I was employed for something over two years by the Crescent Ship Yards, of Elizabeth, New Jersey, under Lewis Nixon, a shipbuilder, building steel ships largely for the United States Government. I had the position there of draftsman in charge of hull construction, that is, the body of the boats. During that time I supervised the construction of four steam pinnaces that were built for the Russian

battleship Retvizan. That is the vessel that was sunk in the Russian-Japanese war by the Japanese. I had charge of and supervision of the construction of the hulls of four Holland submarine boats that were built at Elizabeth, New Jersey; also the hull construction of a fire boat, W. S. Gratton was the name, built for the City of Buffalo. There were some other hulls, but I think that indicates my knowledge.

Q. Have you examined the patents in suit in this case and do you believe that you fully understand the same?

A. Yes.

Q. Have you examined Defendant's devices and the structure thereof?

A. Yes.

Q. Have you examined the prior patents and publications contained in the defendant's Book of Prior Art
189 Patents and Prior Publication here in evidence as Defendant's Exhibit A?

A. Yes.

Q. Do you understand them and the disclosures therein?

A. Yes.

Q. Have you compared all of the claims here in issue with defendant's devices, and particularly those designated as Plaintiff's Exhibits 17 and 18?

A. Yes.

Q. Have you compared the structures of defendant's devices, particularly those designated as Plaintiff's Exhibits 17 and 18, with the disclosures contained in the prior art patents which you have examined?

A. Yes.

Q. Having examined the patents here in suit, the defendant's structures as exemplified by the plaintiff's Exhibits 17 and 18, and the prior art as shown in defendant's Book of Prior Art Patents and Publications, Defendant's Exhibit A, please state whether or not you have found prior patents which show the various features of defendant's devices?

A. To the best of my judgment—

Mr. Wheeler: Objected to as calling for a conclusion. This is the very issue before the Court.

190 The Court: Yes. I will let him answer.

A. To the best of my knowledge, I believe I have.

Mr. Rummler: Q. Will you designate those patents and explain wherein they show features which you believe are the same as those of the devices, Plaintiff's Exhibits 17 and 18?

A. I have a book of prior art patents—

Mr. Rummler: Just a minute, please. Let the record show that the witness is looking at a book of prior art patents and publications which is identical with Defendant's Exhibit A.

A. If I may, I would like to thumb through this book, taking one patent after another, and indicating some feature that is involved in the structures inquired about which I find in these patents.

Q. Please do that, and designate the patents as you go along.

A. The first patent I would like to direct attention to is in the back of the book.

The Court: I do not want to tell you how to conduct your case, as the witness has evidently prepared this case, but I will tell you how my mind operates and the way I will get this, if I ever get it, he will take each claim
191 and then I want to see what you say is prior art in that claim.

Mr. Rummler: All right. We will do that then, your Honor.

Q. You said you have examined the patents in suit and—

The Court: Maybe the witness does not have that in mind. I don't know. Maybe he has it some other way. I do not want to embarrass him if he has some other way of doing it, or you have some other way of doing it. Go ahead.

Mr. Rummler: We will do it in the shortest possible way and the witness can do it the way you suggest.

Q. Taking the claims of the seven patents in suit, beginning with patent No. 1,716,962, please compare the claims and point out wherein the elements of those claims are found in the prior patents contained in the book identified as Defendant's Exhibit A.

A. The claims in issue are claims 11, 12 and 13.

Q. They are 11, 12, 13 and 14.

A. Yes, and 14.

I will read claim 11 and then point out some prior art bearing thereon:

"A propulsion device for water craft comprising a stationary support carrying a bearing, a drive shaft
192 casing mounted to turn in said bearing, a motor mounted on the upper end of said drive shaft casing with its drive shaft disposed within the drive shaft casing

and said shaft passing downwardly therethrough, a housing mounted on the lawer portion of the drive shaft casing and turning therewith, said housing including a substantially horizontal barrel-like portion, a propeller shaft mounted within said barrel-like portion and having a driving connection with the motor drive shaft, a propeller on said propeller shaft, said housing extending upwardly from said barrel-like portion and provided well below its top with an anti-cavitation plate extending rearwardly therefrom overlying the path of forward travel of the propeller blades and said housing having a substantially vertical internal passage leading to the water jacket of the engine, said passage opening at a point below normal water level."

The first patent is the patent to Smith, No. 1,226,400. Those patents are arranged in chronological order in the book so they can be readily found. That patent shows an outboard motor with an anti-cavitation plate mounted above the propeller and extending rearwardly of the shaft housing. The housing of the shaft is tubular and extends from the motor downward to the anti-cavitation plate.

In the back of the book, where the foreign patents are accumulated, there is a patent to Echard, which is a French patent, No. 463,386, February 20, 1914.

193 You have a chart of that, that French patent.

The Court: What is this French patent?

A. Echard. The number is 463,386.

The Court: Yes, I have it now.

A. I am at a little disadvantage here because I have no table to rest this on and it is rather complicated.

This is a French patent and shows every element of the claim except the anti-cavitation plate.

If you will notice down near the bottom of the front edge of the stream lined housing which carries the propeller, there is a water inlet marked 8, and there is an internal passage which runs up from that to the top of that housing. Then it is extended by means of a rubber tube marked 13, which runs to the jackets of the engine.

The only feature of the claim that is not shown in this patent, there are two features, one is that the engine, while apparently on the upper end of the shaft housing, is actually mounted on a structure on the boat and the shaft housing is turnable on a bearing, on the main shaft bearing of that engine for steering by shifting the propeller stream.

The anti-cavitation plate is not shown on that. This was invented in 1913, this French patent was issued,
194 but it has a rib on the rudder frame immediately overlying the propeller, where an anti-cavitation plate would be placed if the device were equipped with one.

Did I mention that the upper part, the engine, is carried by the structure there, and the upper end of the shaft housing is mounted in a manner similar to that in which defendant mounts its housing.

Turning to the forward part of the book, we have patent No. 1,226,400, issued to Smith. I guess I mentioned that.

That patent shows the anti-cavitation plate. That patent was issued in 1917 and is therefore public property. Anybody may use an anti-cavitation plate in accordance with the invention described in that patent, the Smith patent.

I call attention further to Stockemann patent No. 1,-131,287. This patent shows a motor carried at the upper end of the shaft housing. As in the plaintiff's structure, it is mounted on the propeller shaft housing. The steering is effected by means of a tiller marked L. At the lower end of the shaft housing or shaft casing, as plaintiff has called it, is a housing for a propeller shaft. This housing also has at the front, which is at the left of the view,
195 an inlet opening. It is not numbered, but you will notice a slight protuberance where the middle of that spring is, the vertical spring there. That has the passage communicating with an internal passage within the housing, running upwardly and then toward the right and then continuing upwardly inside of a passage which is defined at the outermost pipe G, a casing wall that is, and the pipe F that is inside. They are spaced apart so as to provide an internal water passage for the circulation of water.

This drawing shows the propeller turned to the left, in dotted lines. This does not mean that the rudder steers independently of the propeller, but there is a gear at the end of the handle L which meshes with a structure on the top of the shaft housing whereby, by turning that handle L, one can reverse the position of the propeller so as to drive the boat either forward or backward, in either position, those are the two positions in which steering can be effected. That propeller may be in either

of those. Then it turns and this slip-stream follows the direction in which it is turned.

The rudder blade is simply additional rudder surface
196 to enable one to handle his boat by that turning action.

Patent No. 1,559,616, of November 3, 1925, the Johnson patent.

This patent was issued to L. J. Johnson, et al., that is, L. J. Johnson and Harry L. Johnson, and the issue date was November 3, 1925. It shows an outboard motor and is cited because it also shows the water inlet and outlet in the relationship in which they are shown in the plaintiff's patent.

This patent has no claims to that water inlet. It is merely a disclosure, a prior art disclosure.

It also shows a plate immediately above the propeller, an anti-cavitation plate.

Another patent that should be considered in this connection is the Ducassou patent No. 1,034,987, August 6, 1912.

The Court: Where is there any anti-cavitation plate in there?

A. There is no anti-cavitation plate on that patent. That anti-cavitation plate is called in the specification a bifurcated plate 16. It extends immediately over the propeller.

The Court: Where is it?

A. It is the horizontally disposed bifurcated plate.
197 You will find it described in line 80 on page 1 of that patent.

I did not describe the Ducassou patent. That is No. 1,034,987.

The Court: Is that the one following Johnson?

A. No.

The Court: What is the one next after Johnson?

Mr. Rummler: Ducassou No. 1,034,987.

A. That patent is relied upon and cited because it shows a stream lined, it shows an outboard motor with a shaft housing that is stream lined, that is, it is made narrow and elongated in section. In Figure 1 you will see that the section is quite broad, whereas in Figure 3, on the third page, the width is very narrow, and in Figure 2 there is a dotted outline that indicates the shape of that section, which is a regular stream lined section, such as you see in that Plaintiff's Exhibit 8, in the uppermost sectional view.

The lower housing which houses the propeller in this device rotates for steering. It is stream lined, as is indicated by the dotted outline.

The Court: Dotted outline where?

Mr. Rummler: Figure 2.

A. Around the propeller shaft, you will notice that
198 the propeller shaft indicates this is a stream lined barrel for housing the propeller shaft. All that needs is the addition of the anti-cavitation plate.

It also does not show any of those internal passages, but I have cited it because of the stream lined shaft housing and the stream lined propeller housing.

At the back end of the book, among the foreign patents, there is a British patent to Saunders No. 179,607. This patent shows an outboard propeller housing that has a vertical shaft, a vertical drive shaft housing that extends upwardly through the bottom of the boat and connects to an engine located in the body of the boat. In that case, the bottom A of the boat serves the function of an anti-cavitation plate. This housing is rotated by means of a worm and gear, the worm wheel being indicated at J and the worm at K, which are connected to the propeller, as is indicated in other views.

This housing, this propeller shaft housing, is highly stream lined both as to the vertically extending strut portion and the horizontally extending propeller shaft housing.

That patent was issued in 1921.

Q. How is that Saunders boat steered?

199 A. By turning the drive shaft casing by means of those bevel gears or those worm gears that I have described, and thereby turning the slip-stream of the propeller into the direction to cause turning movement of the boat.

Another patent is the one that immediately follows that, Mandl. The drawing follows the specification in this book.

Q. Will you please give the number of the Mandl patent?

A. The Mandl patent is a German patent No. 345,103, issued December 5, 1921.

This shows an outboard motor with an engine at the top of the drive shaft housing, an internal water passage that has an entrance marked S. It is rather difficult to see in the drawing.

The Court: Where is that?

A. It is immediately above the propeller housing. There is a cover plate on a chamber there that serves as a pump housing, which is marked U. That propeller of that pump housing is marked U.

The Court: Yes.

A. And it has in the upper wall an inlet passage directed downwardly into that pump chamber U. In the pump chamber there is a rotor of the type that is
200 shown in Figure 3. That rotor has a flange, as shown above, and another one below that engages those annular recesses that you see in Figure 1 above and below that pump casing there.

Have I made that clear, your Honor?

The Court: I am not sure that you have.

A. In Figure 3 you will note there is a star-shaped figure above, which is the top view of the rotor view.

The Court: Yes.

A. And below is a sectional view of that element, showing that it is a cylinder with a plate near the bottom, and on that plate are mounted wings which are slightly curved, that is, mounted on the drive shaft, and rotates with the drive shaft so that water is drawn into the opening S.

The Court: Where is S?

The Witness: Are you looking at No. 345,103?

The Court: 345,103.

The Witness: The German patent.

Mr. Rummler: If the Court please, there is large chart here.

The Court: Where is S?

Mr. Rummler: S is right here, and that arrow points to the inlet opening.

201 The Court: Where is S?

(Mr. Rummler indicates S on the chart.)

A. In the photostat of the German drawing that looks like a small S. It is like a written small S.

The Court: All right.

Mr. Rummler: I am pointing to it.

A. That is the inlet opening. It is directed toward the center of that rotor.

The Court: Yes.

A. And those pockets in the rotor throw the water out into those passages that you see, an annular passage completely around the path of that rotor. That is shown by little white notches at the sides of the casing at Figure 1. The rotor is not in place in that view.

From the channel the water passes up through a passage where there is an arrow that indicates the flow upwardly into the passage. That is between two concentric pipes, as indicated by arrows half-way up on the shaft housing or shaft casing, and from there it goes on up to the engine cylinders.

There is one other patent that should be considered in this connection. It is the British patent to Lanchester No. 14,792. That is in the back of the book and is No.
202 14,792, of 1902.

This is in the form of an outboard motor, that is, in the form of an oar. It has the engine mounted on the inboard end of that oar which is pivoted on the transom of the boat and it has at its upper end a propeller, above which there is a plate labeled I, which serves the function of anti-cavitation plate and rides on or near the surface of the water.

In the specification of this patent appears this statement, on page 3, line 3, the specification precedes that drawing: "Water cooling of the motor cylinder may be provided for by a flow and return pipe from the immersed portion of the oar, the aperture of the flow pipe being bent around to face the direction of motion and preferably to receive water from the propeller race. When the circulating pipe is charged it acts to a certain extent as a siphon so that there is little or no head of water to be overcome. In order to start circulation the handle of the oar may be lowered to near the water level. The return pipe may be allowed to discharge above the water level if preferred so that the circulation is visible."

In other words, this device had an anti-cavitation plate and had a circulating system that ran along. It does not say whether it is inside or outside of the housing.

I wish to cite at this time the Pierce patent No. 1,579,-834.

203 Mr. Rummler: That is the Pierce patent, the original of the reissue patent that is in suit.

A. That patent shows a stream lined shaft housing, a propeller housing at the lower end thereof. It is all cast integral, and it shows an inlet water passage leading from a point close to the propeller shaft, having an inlet opening 14 in the front of that housing. Immediately back of that is an impeller of a pump which is shaped like a spiral on the shaft. This impeller works on the principle of the

Archimedean screw and forces water up the passage 16. The outlet passage for this stream line water is at 18.

Q. Will you please refer to Cowles patent No. 1,234,-293?

The Court: Let us take a short recess.

(A short recess was taken.)

A. The Cowles patent No. 1,234,293 was issued January 24, 1917.

The Court: What that Cowles patent cited against?

Mr. Rummler: It shows an under-water inlet, your Honor, as against the first claim of patent No. 1,716,962.

The Court: What is the number of it?

Mr. Rummler: Cowles.

The Witness: No. 1,234,293.

204 Mr. Rummler: The witness is referring to sheet 4 of the drawing.

A. If you will first refer to sheet 1, which shows the general appearance of this motor. It is an outboard motor in the form of an oar pivoted to a gunwhale of the canoe and having the motor at the inboard end and the propeller at the outboard end.

This patent has a drive shaft casing in Figure 9, which is shown on Figure 4. The casing is indicated at 7 and it has inside of it a propeller shaft in the form of a tube 8.

The Court: What figure are you looking at?

A. Figure 9. That is on the fourth sheet, sheet 4. It is a large view that extends across the whole height of the sheet. That is an enlarged sectional view of the outer end, the propeller carrying end of the drive shaft. The propeller is indicated in section at 17, and the outline of the blade is partly drawn in full and partly dotted.

This patent shows an internal water passage leading from a point near the propeller, in front of the propeller, and facing forward. That inlet is designated by the numeral 130. The water enters there and you will see fine dotted lines around the shaft and the numeral 129

205 pointing to fins on the shaft, which cause that water to flow upwardly along the shaft to the engine cylinder. The parts of this motor, that is, those parts that are in the nature of struts, which are indicated at 51, are finely stream lined, as will be indicated in Figure 11, which is immediately above this Figure 9.

Mr. Rummler: Q. Will you point out the application of these prior art patents that you have described to claim 11 of the Johnson patent?

A. Yes. Claim 11, with the exception of the anti-cavitation plate, reads on the Stockemann patent and Echard French patent.

Referring first to the Stockemann patent, which is No. 1,131,287, I think I had better read that claim in connection with that:

"A propulsion device for water craft comprising a stationary support carrying a bearing,"

That bearing is at the upper end.

"a drive shaft casing mounted to turn in said bearing,"

That is the tubular casing G.

"a motor mounted on the upper end of said drive shaft casing with its drive shaft disposed within the drive shaft casing and said shaft passing downwardly therethrough, a housing mounted on the lower portion of the drive
206 shaft casing and turning therewith, said housing including a substantially horizontal barrel-like portion, a propeller shaft mounted within said barrel-like portion and having a driving connection with the motor drive shaft, a propeller on said propeller shaft, said housing extending upwardly from said barrel-like portion"

The housing here can be taken as all that lower part, that is, within the rudder, within the height of the rudder.

"and provided well below its top with an anti-cavitation plate"

There is no anti-cavitation plate in here.

"extending rearwardly therefrom overlying the path of forward travel of the propeller blades and said housing having a substantially vertical internal passage leading to the water jacket of the engine,"

As I described before, that is that passage that enters in the front part, about the middle of the height of that spring that is shown in the housing, and then extends up through the housing to the water jacket of the engine.

Our contention is that it is simply necessary to attach a housing to this and you will find every feature of that claim. Then that claim would be answered completely, the anti-cavitation plate being old, as shown in Smith, and is open to the public.

207 Claim 12 is similar to that claim. I do not think I need to read that claim.

The Court: Which ones of these patents do you refer to particularly?

The Witness: I refer to all of them.

The Court: Yes. Then you went back and talked about a couple of them. Stockemann—

The Witness: Stockemann and the French one, Echard. They are shown in the foreign patents.

Mr. Rummler: Also the Smith patent.

The Witness: And the Smith patent, which shows the anti-cavitation plate.

Mr. Rummler: This is the Smith patent, your Honor.

The Court: I see.

A. The Echard French patent similarly shows those features. It is No. 463,386. It has a water inlet at 8, at the front edge of the housing, an internal water passage leading upwardly through the housing. The walls of that housing are stream lined, and it has every feature, except the anti-cavitation plate, which was mentioned in the Smith patent.

Claim 13 reads as follows:

"The combination of a water propulsion device having a vertically extending turnable propeller shaft"

208 The Court: What is the difference between 12 and 11?

A. The difference is that the housing is referred to as having an unbroken outer wall surface extending upwardly therefrom. Unbroken wall surfaces are shown in the Echard patent. Excuse me. It has not an anti-cavitation plate.

The distinction between those two claims is very slight. Where it refers to the barrel-like portion it says that the housing is formed with a substantially barrel-like portion, in claim 12.

In Claim 11 it says, "said housing including."

Those differences are infinitesimal, but the main distinction, as I understand the claim, is the unbroken outer surface walls that are brought into claim 12, this being shown in the French patent.

The Court: You cited some cases against 12, did you?

A. I cite the same cases; yes, sir; in fact, most all of the claims.

The Court: I see.

A. Claim 13:

"The combination of a water propulsion device having a vertically extending turnable propeller shaft casing provided with an internal water passage, opening below normal water level, a propeller mounted thereon, means for

turning said casing for steering, said casing having an
209 anti-cavitation plate cast integral therewith and located in a plane above the propeller."

This claim is broader than either of the other two and is specifically directed to the anti-cavitation plate cast integral with the casing.

That Smith patent that showed the anti-cavitation plate showed it as you see there on the chart, in that lower view, showed it fastened to the gear housing by means of a collar, which collar is smooth for a considerable distance above the anti-cavitation plate, and the casing below is smooth and uninterrupted, so that the distinction there is having the anti-cavitation plate cast integral.

I do not find that in the Smith patent. The only prior art bearing on the integral casting of such a flange would be the Echard French patent, which shows, as you will see on that chart, a rib projecting outward along the top of the rudder frame, which would be the natural place for an anti-cavitation plate.

Now if an anti-cavitation plate were added to any one of these patents, like the Stockemann patent or the Echard patent, it would be attached at about that height above the propeller.

The Echard patent is for an integral casting, as is
210 shown by the drawings, and naturally any structure like that could be conveniently made by casting integrally.

The 14th claim is similar to the 13th claim, except that it has smooth and unbroken walls on the casing, and also has the integrally cast anti-cavitation plate. Both of those claims have an internal water passage, which I have shown in the French patent to be old, and in the Stockemann patent.

In my judgment, these claims are substantially anticipated by the prior art.

The Court: These patents to which you have referred are cited against all four of these claims?

Mr. Rummler: Yes, your Honor.

The Witness: They are cited by us, your Honor. The Patent Office did not cite them.

The Court: I say you cite them against all of these claims?

The Witness: Yes, your Honor.

Mr. Rummler: Q. Referring now to the Johnson patent No. 1,763,970, will you point out the prior art applicable to those claims?

A. The claims in question are claims 3 and 14. I will read claim 3 and then refer to the prior art:

211 "A propeller carrying casing for a propulsion device of a water vehicle having an anti-cavitation plate directly overlying the path of travel of the propeller blades, and lying below the water level, said casing having a portion projecting above the water level of substantially symmetrical knife-edge or wedge-like stream line contour and having a portion below said anti-cavitation plate, the front vertical edge of which is of substantially bluntly rounded stream line contour and the trailing edge of which is substantially knife-edge or wedge-like stream line contour."

The feature of this patent is the stream lining, having one type of stream lining above its upper portion and having a different one in its lower portion.

Note the patent to Echard. The stream lining of the propeller housing is indicated by shaded outlines which are shaded on the parts which the stream lining refers to.

Q. Are you referring to the Echard French patent No. 463,386?

A. Yes, the one on the chart.

That patent shows the stream lining of different contour in the upper part of the housing than it is in the lower part of the housing. In the lower part it is thin, but blunt on the front edge, that is, the edge at the right, and tapering to a very fine edge at the rear. On the upper part of it is more abrupt, like a sharp-ended ellipse.

212 In addition to that patent, I call attention to the Ducassou patent No. 1,034,987.

The Court: What is the first patent you cited against this second Johnson patent, that is Echard?

The Witness: The Echard patent.

Mr. Rummler: French patent No. 463,386.

The Witness: This Ducassou patent—

The Court: Let me look at this.

The Witness: It is in the back of the book.

The Court: Is there any translation of that?

Mr. Rummler: No, your Honor, we have no translation here.

Mr. Wilkinson: We have a translation. We have not submitted it to the other side yet.

Mr. Rummler: Do you have the translation of that?

Mr. Wilkinson: Yes. Here it is.

(The translation of Echard French patent was handed to the Court by Mr. Rummler.)

Mr. Rummler: Thank you, Mr. Wilkinson.

The Court: All right. What do you say about that?

A. I cite that patent because it shows in the section of the upper part, which is near the water line, a pointed form of cross-section, that is, it is knife-edged both at the
213 front and at the back, and in the lower part, this happens to be below the propeller housing, it shows the forward edge of the stream lining formed bluntly and tapering off to a thin edge.

The Pierce patent, the original of the plaintiff's patent in suit—

The Court: What was the second one? Echard was first, and what was the next one you cited?

A. To Dacassou.

Mr. Rummler: That is patent 1,034,987, your Honor, which was referred to in connection with the first patent.

The Court: No. 1,034,987?

A. Yes. I cited that patent because it shows the straight portion of the shaft casing, that is, the portion that extends above the water line, very wide in Figure 1 and narrow in Figure 3, indicating that it is stream lined. In Figure 2 the exact shape of this stream lining is shown, but that figure itself by light dotted lines. It is very difficult to decipher in Figure 2, but it is shown sharp-edged both at the front and at the back above the water line.

The Pierce patent No. 1,579,834—

The Court: Don't go so fast.

The Witness: Oh, I beg your pardon.

214 The Court: Anything said about stream lining?

A. Yes.

The Court: What does it say about it?

A. No; he shows it. That is all that is necessary to anticipate, your Honor, it shows it.

The Court: I didn't ask you if it was necessary. I asked you if he said anything about it? Does he say anything about it?

A. No.

The Court: What is the third patent?

A. The third patent is the Pierce patent No. 1,579,834.

The Court: What do you say about that?

A. I have not been able to find the patent in this set.

Mr. Rummler: That is the original patent of the reissue patent here in suit.

A. Well, the drawing of that reissue patent will serve the purpose for what I am talking about.

The Court: Well, I saw it a minute ago. Go ahead. I remember it.

A. The Pierce patent shows no anti-cavitation plate, but it shows a strut coming from the propeller housing upwardly above the water level. It shows in Figure 2 the section of that housing above the water level and below
215 the water level. Where that strut is cut away for the
propeller it would necessarily have to have a different type of stream line, in my judgment, because of the fact that the width indicated in Figure 3 at the middle portion is almost equal to the distance from the center of the shaft due to the arc that forms the rear edge of that propeller housing. That would give a section that would be blunt at the rear edge in the lower portion and pointed at the front edge in the upper portion.

We are talking about patent No. 1,763,970 to Johnson, which was filed June 18, 1928, the application for which was filed at that time, whereas this Pierce patent issued, the original Pierce patent issued—

The Court: April 6, 1926, isn't it?

A. April 6, 1926, more than two years prior.

Another patent is the Evinrude patent No. 1,524,857.

The Court: The one in suit?

Mr. Rummler: No, your Honor.

The Court: The Evinrude. What number?

A. No. 1,524,857.

That patent shows a housing that extends, a strut-like housing, around the drive shaft and extends upwardly from the propeller shaft housing and is of stream lined form,
216 as is indicated by comparing figures 1 and 2.

Figure 2 shows the rear view and Figure 1 the side view.

The Court: We will recess at this time until 10:00 o'clock tomorrow morning.

Whereupon, an adjournment was taken until Tuesday, January 30, 1940, at 10:00 A. M.

217 Tuesday, January 30, 1940
10:00 o'clock A. M.

Court convened pursuant to adjournment.

Present:

Messrs. Rummler, Wilkinson, Wheeler.

ENGENE A. RUMMLER resumed the stand for further direct-examination by Mr. Rummler.

The Witness: I was in the midst of a discussion of patent No. 1,763,970.

The Court: Proceed.

A. I will cite again the references that I deem pertinent to the claims in issue in this patent.

The Court: I will tell you what I have down here. I have Echard No. 463,386, Ducasson No. 1,034,987, Pierce, 1,579,834, Evinrude 1,524,857. That is where we were last night.

A. Yes. In addition to those there is Grass No. 1,-639,339, of August 16, 1927.

The Court: Grass, What is the number?

A. Grass, No. 1,639,339, August 16, 1927.

218 May I just list them and then go back?

The Court: Is there anything special you want to say about that?

A. Yes, sir. That shows an outboard motor that is mounted at the upper end of a strut shaft housing which carries a propeller at the lower end and it is stream lined throughout its height and is hinged for steering. The stream lined section is shown on the second page in Figure 3. It is blunt at the front, a pear-shaped section, and sharp at the back.

I think that is all that need be said at this time.

The Court: Yes.

A. Smith patent No. 1,226,400. That has one of the anti-cavitation plates which has been discussed.

Lanchester—

The Court: Don't go so fast. You say Smith?

A. Yes. Smith No. 1,226,400.

The Court: Yes, I remember that one.

A. Lanchester, British patent, No. 14,792, of 1902. That is at the rear of the book, among those foreign patents, and is the outboard motor which has the form of a motor oar.

The Court: What is the number, 14,792?

219 Mr. Rummler: Yes, your Honor.

The Witness: Yes.

The Court: We talked about that one before, didn't we?

A. Yes, sir; with regard to another patent.

The Court: I thought so.

The Witness: That was Plaintiff's Exhibit No. 10 that was referred to before.

Mr. Rummler: With regard to the first patent, your Honor.

The Court: I do not have it down. We talked about that in connection with the first patent, did we?

Mr. Rummler: With the first patent, yes, your Honor.

The Witness: Saunders British patent.

The Court: What especially do you want to call attention to in the Lanchester patent?

The Witness: In the Lanchester patent?

The Court: Yes.

A. This patent relates to stream lining. The Lanchester patent shows the under-water part is a long shaft which is lying almost longitudinally in the water, so that it has a very easy stream lined action in passing through the water. In the straight structures which support that cir-
220 cular plate there is a circular plate that surrounds the propeller, which is in the nature of an anti-cavitation plate, and the struts that support that—

Mr. Rummler: Excuse me. I think you are confusing that with another patent. If you will look at the Lanchester drawing I think you will see.

A. Oh, yes. The Lanchester is in the nature of an oar that overhangs the water so that the straight part, that is, the shaft casing, is surrounded by a cylindrical tube, but lying in the water in such a way that the water flows past it in a very easy way, in stream lined filaments. The anti-cavitation plate mounted above that is also stream lined.

This patent under discussion relates to stream lining and that is the reason that that patent came to be pertinent.

The Lanchester patent also has the water inlets. They are not shown in that drawing, but they are described in the specification.

The Saunders patent is the next patent. That is British patent No. 179,607, of 1921.

The Court: What is this one now?

A. Saunders patent No. 179,607, of 1921.

Mr. Rummler: That is the British patent, your Honor.

221 A. It is the British patent and shows a propeller housing which has a straight portion extending upwardly and is pivoted in the aperture in the bottom of the hull of the boat.

I have discussed the Saunders patent. It has been discussed.

The Court: Did we have that before?

Mr. Rummler: Yes, we did, your Honor, in connection with the first patent.

A. Now claim 3 of the Johnson patent No. 1,763,970 reads as follows:

"A propeller carrying casing for a propulsion device of a water vehicle having an anti-cavitation plate"

Shown by Smith.

"directly overlying the path of travel of the propeller blades, and lying below the water level, said casing having a portion projecting above the water level of substantially symmetrical knife-edge or wedge-like stream line contour and having a portion below said anti-cavitation plate, the front vertical edge of which is of substantially bluntly rounded stream line contour and the trailing edge of which is substantially knife-edge or wedge-like stream line contour."

The Smith and Pierce patents, in my judgment, meet the terms of that claim.

The Smith patent shows the anti-cavitation plate in a propeller assembly such as this. It does not show the
222 stream lining. The stream lining is shown by the other patents cited.

The stream lining is an expedient that is so well known in the shipping art that it scarcely can be regarded as anything requiring invention. It is merely a refinement of surfaces so as to allow the water to pass more freely around the parts.

So I regard those patents as completely anticipating this claim.

Q. What patents were those?

A. Smith and Pierce.

Q. What does Pierce show in particular?

A. Pierce shows a structure which is stream lined throughout its height and has a sharp edge presented at both the front and rear section.

Would you please find it on there?

Mr. Rummler: We do not have a chart for the Pierce patent, but the drawing is shown in the reissue patent which is here in suit, reissue No. 18,118.

A. Assuming that the anti-cavitation plate is added to the Pierce patent at some point below the water line, you would have those sharp edges presented at the front, both in front and in back, above the water line. Below the water line you would have a section that is blunt at the
223 rear and pointed at the front, but I think the claim
calls for being bluntly rounded stream line contour at the front vertical edge of the lower portion. The difference is merely a turning around of that stream lined section.

I have shown in a number of those patents that the bluntly rounded front edge of a stream lined section is a very common section for a strut below the water line. It is present in a great many of these patents.

Q. How does the Ducassou patent No. 1,034,987 apply to this claim 3?

A. The Ducassou patent shows a shaft housing that is stream lined throughout its height and carries a propeller housing at the lower end. In the Ducassou patent the stream lined section is indicated in Figure 2 as being pointed at both ends.

That is rather difficult to see in that drawing because it is a dotted line. It is No. 1,034,987.

Of course, it is immaterial in a structure of that kind where the cut be made for the turning of the lower part. If an anti-cavitation plate were to be added to that, the swivel joint at the bottom of that strut would be put at
224 at higher point so that the anti-cavitation plate could
be added and the cut would be made higher up. But structurally and mechanically the structure would be the same.

Q. How does the Grass patent No. 1,639,339, apply with reference to claim 3?

A. The Grass patent shows a housing that is stream lined throughout its height and if an anti-cavitation plate were added to that it would be attached somewhere below the point where you see the line 3-3. That is stream lined, being blunt at the front end and tapered to a sharp edge

at the rear. In that case the same sort of stream lining is presumed to be used throughout the height and it would differ from that claim merely in not having the sharp-edged stream lining above the anti-cavitation plate, which sharp-edged stream lining would, however, be shown by the Pierce patent, the reissue Pierce patent or its original. The reissue is No. 18,118.

I do not find in the defendant's device the element which reads, commencing in line 35, "said casing having a portion projecting above the water level of substantially symmetrical knife-edge or wedge-like contour."

Q. Which defendant's device are you referring to?
225 Maybe you might take them in order.

A. Taking them in order—

Q. The 9-horse power motor first.

Mr. Wheeler: We do not allege the 9-horse power motor to infringe this patent, only the 16-horse power.

Mr. Rummler: All right.

Q. Refer to the 16-horse power motor, as shown in Plaintiff's Exhibit 8.

A. The 16-horse power motor, you might call that a sharp edge at both the front and the rear. They are slightly rounded, but I think they are within the spirit of what might be called a knife-edge structure. It has this same structure below.

I am referring to the sections in Plaintiff's Exhibit 8, which I think shows those sections accurately.

I do not find in the defendant's motor, the 16-horse power, the last element, "the front vertical edge of which is substantially bluntly rounded stream line contour and the trailing edge of which is substantially knife-edge or wedge-like stream line contour." That is referring to the part that is below the anti-cavitation plate.

The Court: Well, they say that the intake there is a flattening for the front edge. What do you say about
226 it?

A. I do not regard it so. The front edge is— It has a drag on the stream lined surface. The front fin that projects would divide the water and under extremely high speeds would cause the water to spread, but then the surface back of that is blunted. It is a step surface.

Mr. Rummler: Q. Would you say that the fin constituted the knife-edge in the section at the inlet?

A. Yes.

Q. Is that fin a continuation of the knife-edge section which is above the inlet?

A. Yes. If the contour were not broken for the purpose of making the hole there, it would be a knife-edged surface. The inlet necessarily involves making an opening in the surface and that is done by stepping it in.

Q. Then would you say that the inlets were cut out of the stream lined surface rather than added on it?

A. Yes.

The 14th claim is somewhat broader than claim 3, in that it has but one limitation to the specific form of section, namely, the bluntly rounded stream line contour below the anti-cavitation plate.

I will read that claim.

227 "A propeller-carrying casing for a water propulsion device having its upper portion adapted to project above the normal water level, said casing being of stream line contour from top to bottom; and that portion below the normal water level having its front edge of bluntly rounded stream line contour with a trailing edge of substantially knife-edge stream line construction."

That claim is very broad in that it covers the stream lining with respect to the water level. It does not contain the anti-cavitation plate. It simply means that it has a stream lining below the water line. It is bluntly rounded in front, without referring to how the stream lining might be above.

The claim refers to a water propulsion device. Of course, it is not a water propulsion device. It is a propulsion device operated on the water. I merely mention that in passing.

Q. How would you apply the Ducassou patent No. 1,034,987 that you referred to?

The Court: Do you agree that the combination of the two sorts of stream lining offers the least resistance to the travel of the boat through the water, that is, the least resistance of the boat through the water, do you agree with that?

A. The stream lining is a great help in passing through the water.

228 The Court: That is not what I asked you. That is not the point.

A. No, I do not regard it as the best.

The Court: Do you think the combination of those sorts of stream lining is an advantage?

A. Yes, I think there is some advantage.

The Court: What are the advantages?

A. When the thing is totally submerged, a stream lining that is sharp-edged is less likely to create a bow wave. It will separate the water more easily at the front edge near the surface of the water than the bluntly rounded stream line edge would do at that point.

On the other hand, your Honor, when the stream lining is submerged to a depth where it is completely submerged, the pear-shaped bluntly rounded front edge is generally regarded as the best form of stream lining.

The Court: Why?

A. Because the water filaments tend to follow that form of a surface.

We have some references here to which I intended to refer originally, but in applying these matters claim by claim I have not had an opportunity to bring those out.

There is some literature that shows the studies
229 made of stream lining and shows the distinction between these different kinds of stream lining, but the point I want to make in that regard is that back of a boat, where the rudder is, where this device stands, the water is very turbulent. It is not running in true stream lined flow like a solid body of water will. The boat has passed through it and disturbed it and the propeller working there has created agitation.

All of those things operate, so that the efficiency that would seem to go toward stream lining is very slight, practically, I mean.

I would apply this claim 14 to the Grass patent No. 1,639,339.

With an anti-cavitation plate added to that, you see that the part below the water line would then have—Oh, I beg pardon. The anti-cavitation plate is not in this claim, but the part below the water line there is bluntly rounded at the front.

The question in this claim is, of course, whether there might be invention in having a bluntly rounded stream line below the water line on a propeller construction of this kind.

Mr. Rummler: Q. Referring to the drawing of this patent that you are looking at, No. 1,763,970, and par-
230 ticularly Figure 3, would you say that all that portion below the water line was of bluntly rounded contour on its leading edge?

A. No. The water line would stand somewhere above the anti-cavitation plate and there would be a portion above the anti-cavitation plate that is sharp at both edges, both the front and rear edges, as shown in Figure 6, which shows a section, shows the formation of the structure in that portion that is above the water inlet which you see curving out to the back. That portion is of sharp-edge construction, both front and back.

The section that you see in Figure 5 is a bluntly rounded front edge at the point where the line 5-5 is shown in Figure 3. Therefore, you would have part of the portion that is below the water level, that would be bluntly rounded at the front edge and part would be sharp.

I do not regard the defendant's devices as meeting the terms of that claim, that is, that portion below the water level having its front edge bluntly rounded and stream line contour. I read that, of course, to mean all that portion below the water line has its front edge bluntly rounded stream line contour and its trailing edge substantially knife-edge-like construction.

231 The Court: Mr. Wheeler, which one of these devices do you say is not claimed to infringe all of these claims of this patent?

Mr. Wheeler: The smaller of the two motors of Defendant is not claimed to infringe this patent at all, the device of Plaintiff's Exhibit 5 here, your Honor.

The Court: But the other one is claimed to infringe all of these claims?

Mr. Wheeler: Those two claims, 3 and 14.

The Court: Are those the only two in suit?

Mr. Wheeler: Yes, your Honor.

Mr. Rummler: Yes, sir.

Q. Referring now to the Evinrude patent No. 1,786,835, what prior art do you find that is pertinent to the claims of that patent which are in suit, namely, claims 1, 4, 5, 8, 9 and 10?

The Court: You are now going to another patent?

A. Yes. No. 1,786,835, Evinrude.

Pertinent to that patent I regard the Pierce patent—

The Court: Just a minute. Now is this the same Pierce patent you referred to a while ago?

A. Yes, sir; it is the original of that patent.

The Court: That is Pierce 1,579,834?

232 A. Yes, sir.

The Court: What are these, interior water passages?

A. Yes, they are interior water passages. One is an inlet, the one at the front, that is, the side opposite the left in Figure 1 is a water inlet that extends downwardly. That is the inlet passage. It extends downwardly to a rotor on the propeller shaft and that is the inlet marked 14. The other passage 18 is the water outlet.

The German patent to Mandl No. 345,103, December 5, 1921.

This patent shows, in general, the enclosed water inlets and a rotary pump in the part that is marked U, which is above the propeller housing.

I have described that, your Honor, and I suppose I can pass on.

The Court: Yes.

A. Those two patents were cited by the Patent Office. The remaining references which I will refer to were not.

Ziegenspeck, Swiss patent, No. 58,818, December 26, 1911.

This patent is an outboard motor construction that turns as a unit and has a water inlet at the front with a pipe
233 leading up to the engine. I will refer to it again in reference to other patents.

That particular Ziegenspeck patent is nct very important in this regard, your Honor. I included it among the references for the purpose of making an analogy.

The Court: What are you going to refer to now?

A. The Cowles patent.

The Court: What?

A. Cowles, C-o-w-l-e-s patent No. 1,234,293.

This patent shows in Figure 9, on page 4, another form of pump with an inlet marked 130.

The court: You referred to this once before, didn't you?

A. Yes, sir.

The Court: In connection with what patent? I thought I was putting these all down.

Mr. Rummler: In connection with the first patent, your Honor, 1,716,962.

A. Many of these patents will be referred to in connection with each one of the patents, each one of the plaintiff's patents, because they all have a close bearing on the claims and it is necessary to repeat the citation of them. I thought at first I might have gained time
234 by just going through the art and then reviewing it.

The Court: You might gain time, but you had better tell me to what claims they relate if you want me to understand it.

The Witness: Thank you. Would you rather have me list these now and then read a claim and then cite the references with respect to that?

The Court: Just so you take time enough to tell me everything you want me to know about, so I am sure to know what claim you are referring to and what patent you are talking about.

What about Cowles and Evinrude 1,786,835?

A. Cowles is another example of a different form of pump with the inlet in what corresponds to the lower part of the housing, and it has enclosed water passages, which are the points involved in this particular patent, which is a water cooling system. I mean patent No. 1,786,835 of Evinrude that is under discussion.

Echard No. 463,386, the French patent.

This patent shows in general an outboard motor with a stream line housing at its lower end, a water inlet at the lower part marked 8, a pump for impelling the water from that outlet to a pipe 13 leading to the engine cylinders.

235 I direct your attention to the water inlet 8 at the front of the propeller housing with a passage leading where the numeral 4 occurs upwardly through the housing to a duct that leads to the engine cylinders.

The Court: Where is the pump?

A. The pump stands vertically. You see the spring opposite the part 4?

The Court: Yes.

A. Immediately below that is a piston which has a valve in the center of it and has a passage below it communicating with the passage 8, so that the water entering the passage 8 passes up through that cylinder and flows vertically through the housing until it passes the valve 11, when it enters the pipe 13 that leads to the engine cylinders.

This patent also involves another form, a slightly different form of pump, and in that connection I cite the Szekely patent No. 1,295,234, February 25, 1919. Referring to Figures 3 and 4, this patent shows in a water cooling system for an internal combustion motor a casing that has a spiral form surrounding an impeller in the form

of a rotor, a disk that has a number of blades on it and
the passage surrounding that disk is of spiral form
236 so that it accumulates the water as it goes around.

The water inlet is indicated in the upper view by dotted lines extending towards the left, and it opens, as shown in Figure 4, from beneath the rotor and is then impelled by the blades into the spiral passage and out through the other point.

In Figure 1 of this drawing, this pump is shown in a different position, but it is just a question of adapting the pump to the position shown in Figure 4 to meet the terms of some of these claims, as I will point out.

Mr. Rummler: Q. Does that inlet opening in the pump of the Szekely patent enter at the center of the pump?

A. Yes.

Q. Or is it the center of the pump impeller?

A. Yes, it is in line with the shaft. It is shown very clearly in Figure 4.

Butler patent No. 1,274,678, August 6, 1918, shows a similar pump.

The Court: What do you say about it?

A. It shows a similar pump for a water cooling system in which there is a rotary impeller having curved blades and, as you see in Figure 4, the water enters at
the center around the drive shaft and is then thrown
237 out by the blades through a peripheral opening marked
6 in Figure 3. It is just another form of that type of pump.

Applin patent No. 1,366,149, January 18, 1921.

Referring to Figure 4, this will be seen to be a pump with a central water inlet around the drive shaft, a plate marked 55, which is a disk, around the drive shaft, and that disk carries a series of impeller blades 54. These blades are of spiral form, as is shown in Figure 3. The water inlet is shown there in the center surrounding the shaft 13, coming up from beneath, and the casing around that is spiral.

In this instance the pump is feeding two cylinders and consequently it has two outlet passages. It is of the same general type as that which is shown in the plaintiff's patent, Plaintiff's Exhibit 13.

Now referring to claim 1 of patent No. 1,786,835, this claim reads as follows:

"In combination with an outboard motor having jack-

eted cylinders, a drive shaft actuated from the motor, a propeller shaft geared to the drive shaft and having a propeller fixed thereto, a housing for the drive and propeller shafts and the gearing, said housing including sections having co-acting means defining a pump chamber,"

Mandl has all of those.

"an impeller in said chamber actuated from the drive
238 shaft, the lower section of the housing having an inlet to the pump chamber opening forwardly at a point adjacent the propeller shaft whereby to be well submerged, the other section having an outlet leading therefrom, and means connecting the pump outlet with the jackets of the cylinder."

I regard Echard, Pierce and Mandl as meeting the terms of this claim. Echard is the French patent.

The Court: You regard Echard, Pierce and Mandl?

A. Yes, sir.

Mr. Rummler: Yes, your Honor.

A. Referring first to the Echard patent No. 463,386, every essential element of that claim is found there. The inlet opening is found in the lower part of the front of the propeller casing, the impeller is in the form of a piston for pushing water from that outlet to the pipe 13, and that is in the housing, and the inlet opening is adjacent the propeller shaft.

The Mandl patent (German) No. 345,103, shows almost the same arrangement. In this case the inlet opening is on the upper side of the valve housing, but it is below the water line and it is at the front of the casing, near the propeller housing. It is simply a matter of choice of arrangement where the inlet which is directed toward the center of the impeller might be on either side of the disk that carries the impeller blades. It is quite immate-
239 rial, as far as the mechanics are concerned, whether that be above or below.

Mandl fails to meet the terms of the claim for that reason, that it is not in the lower part of the housing, this inlet.

The Pierce patent, which corresponds to the reissue patent in issue, shows an impeller in the form of a spiral. This is on the propeller shaft itself and takes water from the opening which is indicated at 14 near the propeller away down below the water line and forces it upwardly. That is patent No. 1,570,834.

Q. Referring to the German Mandl patent No. 345,103,

do you find all of the elements of claim 1 shown in Mandle, except the specific arrangement of the inlet opening?

A. Yes.

Q. Will you read claim 1 on Mandl?

A. (Reading):

"In combination with an outboard motor having jacketed cylinders, a drive shaft actuated from the motor,"

That is the vertical shaft.

"a propeller shaft geared to the drive shaft"

At the lower end.

"and having a propeller fixed thereto, a housing for 240 the drive and propeller shafts and the gearing,"

Which is there at the lower part of the structure.

"said housing including sections having co-acting means defining a pump chamber,"

That housing is made up of two main castings, the large one that encloses the bevel gears that drive the propeller, and a cover plate which forms the upper part of the impeller housing.

"having an inlet to the pump chamber opening forwardly at a point adjacent the propeller shaft"

That is the inlet. It is marked S at the forward side and it is near the propeller shaft.

"whereby to be well submerged,"

That is, well below normal water line. Any pump inlet that is to such water from the stream must be well below the water line or it would not draw water.

"the other section having an outlet leading therefrom, and means connecting the pump outlet with the jackets of the cylinders."

This claim reads directly on Mandl, with that one exception that I have mentioned before, that the inlet S is in the same section of the pump housing as the outlet that is, they are both in the upper section.

Q. In reading claim 1 I believe you left out an 241 element, that is, the impeller in said chamber actuated from the drive shaft. Do you find that impeller so arranged in the Mandl patent?

A. Yes, that impeller is shown enlarged at the side in Figure 3 and it has runners, that is, it has a tubular bearing member that seats in channels above and below the shaft, the shaft presumably fitting in the center opening of the impeller. If it is not on the shaft it would not drive. Consequently, it would have to be fastened to the shaft.

Q. And that impeller is fastened where, can you indi-

cate that by any character on the drawing of the Mandl patent?

A. You mean in Figure 1 of the patent?

Q. Yes.

A. Fastened at U, in that chamber U that impeller is seated.

Q. With regard to the inlet opening to the pump chamber opening forwardly at a point adjacent the propeller shaft, which patent do you find showing that arrangement?

A. The Echard French patent and the Pierce patent. They both show the inlet at a point close to the—Pierce doesn't have any impeller in it. It is only cited to
242 show a different kind of a pump.

My object in citing those several different pump patents was to show that an impeller is something more than a mere rotary device. It may be either a pump or a spiral or anything that pushes the water.

Q. That is, it might operate under another principle than centrifugal force?

A. Yes.

Q. Referring to claim 4 of the Evinrude patent No. 1,786,835, will you read that claim and show where the elements are found in the art.

A. (Reading):

"In combination, an outboard motor having a water cooling system, a propeller, driving means for the propeller, a housing for the driving means made up of a pair of sections having co-acting structure defining a pump chamber, an impeller operating in the pump chamber and actuated from the driving means, the lower section of a housing having an intake opening and having an internal wall defining an inlet passage leading from the intake opening to the pump chamber and also defining a separate gear chamber for elements in the driving means, and a connection between the discharge of the pump and the water cooling system."

All of the elements of that claim are very common in most of these references.

The lower section of a housing having an intake opening and having an internal wall defining an inlet passage
243 leading from the intake opening appears to me to be the main point that needs to be discussed in this connection in order to determine the question of patentability of this claim.

Again I would refer to Pierce and Mandl as showing es-

sentially that. The claim reads "a housing," but I presume that is intended to mean "the housing," meaning the housing that has been referred to.

Q. Where in the Mandl and Pierce patents do you find an internal wall defining an inlet passage leading from the intake opening to the pump?

A. Did you say the Mandl patent?

Q. Mandl and Pierce.

A. The Mandl patent has a wall separating the intake opening, that is, separating the pump chamber from the gear chamber. That is the function of that element, that is, the wall immediately below the impeller going horizontally across.

Was the other patent you mentioned the Pierce patent?

Q. Pierce, yes.

A. In the Pierce patent the inlet opening is designated 14 leading to the pump and, of course, there the water entirely surrounds this hub that is shown at 13, a
244 bearing member there, but immediately back of that impeller is a wall that extends upwardly, being of solid material, that divides the pump chamber from the gearing chamber.

Q. What difference do you find, if any, between claims 4 and 1?

The Court: Let us take a recess at this time for a few minutes.

(A short recess was taken.)

A. The difference between claim 4 and claim 1 is that claim 4 includes the element of a housing having an integral wall defining an inlet passage leading from the intake opening to the pump chamber and also defining a separate gear chamber for the elements in the driving means.

The Pierce patent I was referring to has a wall, being an integral part, and has what amounts to a partition separating the inlet passage from the gear chamber in the lower part of that. The Pierce patent has also a chamber that is divided as specified in the claim.

Q. Referring now to claim 5 of the Evinrude patent, please explain that.

A. Claim 5 is specifically directed to the pump
245 structure. I will read that:

"In combination, an outboard motor having a water cooling system, a drive shaft actuated from the motor, a propeller geared to the drive shaft, a housing for the drive

shaft, said housing having spaced transverse walls defining a pump chamber, said walls having openings through which the drive shaft loosely passes, the peripheral wall of the chamber being excentrically or spirally curved, an impeller operating,"

The word "in" is omitted there. It should be operating in the pump chamber.

"(in) the said pump chamber and including a hub fixed to said drive shaft, a plate-like body fixedly connected to the hub and bearing against one wall to close the opening thereof, and vanes fixed to rotate with the hub and body located on one side of the body, the housing having an inlet communicating with the unobstructed opening of the pump chamber, and discharge means communicating with a peripheral portion of the pump chamber, the vanes having wiping contact with the peripheral wall for a portion of its angular extent."

The Mandl patent shows substantially this structure when taken together with the Z plate or one of those pumps with a spiral chamber.

The Mandl patent shows the pump chamber made by divides sections of the housing and a rotary impeller device mounted on the shaft.

It differs mainly in that it does not show the spiral casing surrounding the pump impeller, but shows a circular casing instead.

246 These are well-known forms of pump.

The action of a pump of this kind is to cause the water to flow from the center of the impeller outwardly toward this periphery and there to be accumulated for delivery to the water lines.

The better structure is the spiral housing around that because it avoids places where the water might change its rate of flow, as might occur in the Mandle device where the chamber surrounding the pump impeller is entirely circular and of the same diameter throughout. However, the pump would work just as well, or any one of these forms of pump, in such a structure.

Q. Then to meet the terms of claim 5 you would pick what patent?

A. I would pick Mandl, Pierce, Szekely, Butler and Applin, the last three being merely to show a well-known use of the type of pump that is specifically specified in this claim.

The Pierce patent shows still a different form.

All these forms are equivalent and if substituted for the pump in the Mandl patent they would practically meet that claim.

Q. With regard to claim 5, do you find any elements recited in the claim that are not present in defendant's
247 16-horse power motor or the 9-horse power motor, as shown in Plaintiff's Exhibits 5 and 8?

A. Yes. In the 16-horse power motor the pump chamber is shown immediately above the anti-cavitation plate. In that view it is shown immediately above the anti-cavitation plate. The claim, in about the 118th line, reads as follows: "said walls having openings through which the drive shaft loosely passes,"

The lower wall through the anti-cavitation plate of defendant's device clears the shaft. In the upper wall there is a bearing that entirely closes that upper wall, so that this element does not read on the walls in plural as specified.

The claim also reads, a little further down, "a plate-like body fixedly connected to the hub and bearing against one wall to close the opening thereof."

In the patent that is a plate that carries the impeller vanes and is on top of the propeller and closes the opening to the upper part of the shaft housing, whereas in the defendant's structure that plate does not bear on that wall but is held by a bearing. The impeller is held from moving upwardly by a bearing that is mounted
248 in that partition. That provides a space.

In this drawing it does show a bearing there. I am thinking of the structure as a unit.

The edges of that impeller have a slight clearance from the edges of that wall that is above there and the chamber is closed by the bearing rather than by the impeller bearing on that surface.

Q. With regard to the vanes of the impeller having wiping contact with the peripheral wall of the pump chamber, what do you find in the defendant's devices?

A. There is a clearance all around the impeller. The impeller does not wipe against any wall. It does not need to wipe against any wall. Just as in the Mandl patent, it might be equally spaced from all of the walls or it might have considerable clearance. It does have considerable clearance in the defendant's structure.

Q. That is, do the vanes of the impeller contact the peripheral wall of the pump chamber at any point?

A. No, there is no wiping contact there.

Q. Do you find that to be the case in both the 9-horse power and the 16-horse power motors?

A. Yes.

Q. Now with regard to claim 8 of the Evinrude patent, will you read that claim and point out how the prior
249 art patents apply.

A. The claim reads as follows:

"In an outboard motor having an engine, a propeller and an upright drive shaft operatively connected with said engine and said propeller, of a shaft housing of substantially stream lined contour in horizontal cross-section in its submersible portion, the shaft being disposed in the widest part of said housing and the walls of said housing being extended convergingly at the rear of the shaft, of a water circulation system including a pump chamber in the wider portion of said housing at an intermediate point therein,"

That far most of the claim is very common practice in the prior art and is found in many of the structures.

"A water passage formed in said housing below said chamber and leading centrally thereto from an inlet disposed materially therebeneath, and a delivery passage formed above said chamber between the rearwardly converging walls of said housing, together with a centrifugal pump runner mounted on said shaft within said chamber."

Mandl and Echard, taken with Szekely, would anticipate the terms of this claim. I can see nothing in the combination alleged that to my mind represents inventive novelty.

In the Mandl patent the one thing that is lacking is having a water passage running below the water inlet passage going to a point below the rotor. This is shown in the French patent of Echard, but Echard
250 shows a different type of pump.

The delivery passage formed above said chamber between the rearwardly and converging walls of the housing, that is like the Pierce patent.

The centrifugal pump runner mounted on the shaft within the chamber, that is a feature of Mandl, and also any one of those water circulation pumps, such as Szekely and Butler, they are all centrifugal pump runners.

Q. Referring to claim 9 of the Evinrude patent, will you read that claim and point out wherein the prior art patents apply?

A. (Reading):

"In an outboard motor structure, a lower unit comprising a sectional shaft housing having an anti-cavitation plate adjacent which the shaft housing sections are secured together, the abutting ends of said sections being formed to provide a pump chamber constituting an enlargement of said plate, a pump in said chamber operatively connected for operation from said drive shaft, an inlet passage leading to said chamber from below said plate, and a delivery passage leading upwardly from said chamber above said plate."

The structure defined in this claim is found in the Mandl patent, except for the fact that there is included in the combination an anti-cavitation plate which, of course, the Mandl patent does not have. That anti-cavitation plate, as previously described, is old,
251 as shown by the Smith patent.

It is customary to divide a pump chamber and if you had an anti-cavitation plate and that plate were used to form a pump chamber, it would be enlarged. The question is whether the application of a pump chamber above an anti-cavitation plate is an enlargement of that plate. That is a question of judgment.

Q. Would you consider the pump chamber of defendant's devices to be an enlargement of the anti-cavitation plate?

A. No. I regard the pump chamber of the defendant's structure as being devoid of performing any anti-cavitation function and the anti-cavitation plate is present in the defendant's structure as an entire unit, with marginal portions extending around the pump chamber. In the plaintiff's structure the pump chamber is provided with flanges which do extend out a considerable distance and are attached to the anti-cavitation plate and might there justify the expression "enlargement of an anti-cavitation plate." Otherwise, I have been unable to apply that term as I have been unable to find the basis for that term except by that fact of that enlargement, unless enlargement might originally have been
252 intended to mean that the anti-cavitation plate in the vicinity of the pump housing was broadened, which might answer the term "enlargement."

The Court: Is it horizontal or vertical?

A. Vertical in that view in Figure 5.

The Court: Is it thickened?

A. Not thickened. It is thickened as I said, in Figure 5. There it is broadened. The anti-cavitation plate is widened so it does have some margin sticking out beyond the pump housing and has some anti-cavitating function. The mere thickening does not help the anti-cavitation plate, although it answers this claim 8 which refers to an enlargement of the anti-cavitation plate.

Q. In the specification of the Evinrude patent did you find anything that would indicate what is meant by enlargement of the anti-cavitation plate?

A. No, I did not. I was unable to find that in the specification, although I looked for a defining description that would explain my doubt as to the meaning of the term enlargement, as to whether it meant thickening or widening, or what it might mean. There is no explanation of that in the specification, as far as I recall.

Q. With regard to defendant's construction, would
253 you consider the pump chamber as having any function with the ant-cavitation plate or as being any part of the anti-cavitation plate?

A. In defendant's structure, did you say?

Q. Yes.

A. No, An inner portion of the anti-cavitation plate is a part of the pump chamber, but I do not regard the pump chamber as being a part of the anti-cavitation plate in any way.

Q. It does not perform any of the functions of the anti-cavitation plate; do you find that it does or does not?

A. I find that it does not, in my judgment. I would think that it would be a detriment to have a pump chamber there. It would be an improved structure if you could do away with the pump chamber, and smooth out those surfaces so that the anti-cavitation plate would have a free flow of water over it.

Q. With regard to claim 10 of the Evinrude patent, will you read the claim and show how the prior art patents have a bearing upon it.

A. Claim 10 reads as follows:

"In an outboard motor, a lower unit comprising an upright drive shaft and a housing therefor of approxi-
254 mately stream lined contours in horizontal section, the submersible portion of said housing being provided with an anti-cavitation plate centrally thickened in a vertical direction and having internally a pump

chamber, pumping means disposed in said chamber and operatively connected with said drive shaft, a water supply passage partitioned from said drive shaft in a forward portion of said housing and leading to said chamber from a point therebeneath, and a delivery water passage partitioned from said shaft in a rearward portion of said housing and leading upwardly from said chamber."

Again, I would point to Echard, the French patent, and Mandl, the German patent. Neither of these patents shows the anti-cavitation plate, that being a structure that was not involved in those particular patents, but it shows the pump chamber in the German patent; the inlet to the pump chamber is on the upper side, but in the French patent the inlet to the pump chamber is on the lower side. However, the German patent shows the structure of the pump chamber and driven directly from the drive shaft. The water supply passage is also partitioned away from the drive shaft, I would say there, by means of the hub of the propeller, which completely houses the drive shaft, the hub of the impeller, I should say.

Q. In the Echard patent how is the water supply passage partitioned from the drive shaft?

A. In the Echard patent the water supply pas-
255 sage is partitioned by a vertical wall which is seen
between the— Well, it is the casing of the pump, the pump casing itself forms a complete partition there that divides that from the chamber in which the shaft housing is located.

Q. So that in the Echard patent there is no communication whatsoever between the water supply passage and the gear chamber, is that so, do you find it so?

A. That is true, to the extent that the lower portion of the pump piston would be tight enough to exclude the communication between those two chambers. The piston is a complex structure. It has really two pistons, one above and one below, the lower one being a seal for the passage, for the opening, and the lower one being a pump piston.

In the Pierce patent there is, of course, a complete separation. The pump chamber is divided again by the horizontally dividing line between the upper casting and the lower casting.

Q. In this claim 10 the second element of the claim

reads, "the submersible portion of said housing being provided with an anti-cavitation plate centrally thickened in a vertical direction and having internally a pump
256 chamber." What, in your judgment, is meant by that expression?

A. Well, in the structure of the patent the upper part of the pump chamber, that is, the upper housing member in Figure 7 there, you see that part that is marked 19, that flange that is marked 19 serves as a thickening of the anti-cavitation plate. That permits that claim to be read on the plaintiff's structure, the structure of the patent, but in the defendant's device that pump housing is simply mounted on top, without having any flanges that go out to the marginal edges of the anti-cavitation plate.

Q. In the Evinrude patent, and particularly Figure 3 of the drawing, do you find that the pump chamber is in any way set down into the anti-cavitation plate?

A. Yes. The anti-cavitation plate itself is recessed and the pump chamber is formed partly in the anti-cavitation plate and partly in the casting which is above it.

Q. Do you find that the pump impeller runs partially in the recess in the anti-cavitation plate and partially in the housing of the upper portion?

A. Yes. I would not regard that as a thickening of the anti-cavitation plate necessarily, because it is all inside of the structure. I think when one refers
257 to a thickening of the anti-cavitation plate one must have in mind the outboard motor features that are functioning as an anti-cavitation plate.

Q. Do you find anything in the specification of the Evinrude patent that will tell you what is meant by an anti-cavitation plate centrally thickened and having internally a pipe chamber?

A. No, I do not. The only reference to the cavitation plate is on page 4, line 30, where it says the lower section of the housing may have a cavitation plate C integral therewith. Immediately following that it defines the pump chamber and says it may be built in the housing well above the water line and so may be of any size without increasing the resistance to the forward motion of the boat. Further, the impeller is driven from the drive shaft and at drive shaft speed.

No, I do not find anything in the specification that defines that thickening.

Q. In defendant's device as shown in Plaintiff's Exhibits 5 and 8, do you find an anti-cavitation plate centrally thickened in a vertical direction and having internally a pump chamber? You may refer to the 16-horse power motor, as shown in Plaintiff's Exhibit 8.

A. The 16-horse power motor?

258 Q. Yes. That is Plaintiff's Exhibit 8.

A. Well, the anti-cavitation plate is slightly thickened centrally because it is made with a slight taper so that it will draw in the casing, but the pump housing is mounted above it. However, the central part of the anti-cavitation plate serves as a part of the pump housing, but it is not thickened by the pump housing in any way, in my judgment.

Q. Would you say that the anti-cavitation plate of defendant's devices had internally a pump chamber?

A. No. It has a pump inlet passing through it.

259 Q. Referring now to Irgens patent No. 1,869,749, which is one of the patents here in suit, and particularly claims 1 and 2 of that patent, what prior art do you find that has a bearing on those claims?

A. Perkins' patent No. 1,131,862, shows an under-water exhaust. That is about the main thing.

Q. What other prior art patents do you find pertinent to claims 1 and 2?

A. I should have said an under-water exhaust outlet.

The Court: What patent do you say now?

A. It is No. 1,131,862.

The Court: Perkins?

A. Perkins. That patent shows an exhaust pipe on the right hand side of Figures 1 and 2 and a connection to the engine cylinder marked 28 at its upper end. The lower end of that pipe extends to a point close to the propeller, immediately above the propeller, and intended to be under the surface of the water.

260 Q. What other patents do you find that have a bearing on those claims?

A. Miller patent No. 1,073,920, September 23, 1913. This patent also shows an under-water exhaust outlet leading from the exhaust manifold.

Q. What other patents do you find?

A. Hardy No. 1,169,030, January 18, 1916. This patent shows a muffler for silencing the exhaust of an internal combustion engine and shows a series of tapered exhaust pipes large at the inlet end and small

at the outlet end. The dimensions of these are such as would have the proportion of inlet and outlet that are defined in the specification as the range.

The Patch patent No. 1,357,079.

Q. Do you find that patent there?

A. Apparently it has been left out of this binder.

The Court: I have it.

A. Patch patent No. 1,357,079, October 26, 1920, for a muffler.

This drawing shows a heart-shaped structure at one side, it is shown in Figure 1, which would correspond to the taper specified in the patent. In this opposite sec-
tion it is flat sided, so that at the section line in-
261 dicated by *y*, the line y-y would be rectangular,
oblong rectangular.

Q. What is the ratio of the end areas?

A. Well, the ratios given there would be the proportions of the line y-y and the outlet end because it is of uniform width throughout, and I should estimate that that is about six to one.

Q. What is the purpose of the Patch device as indicated by the specification?

A. The specification states on page 1, in lines 8 to about 17:

"This invention relates to mufflers for the exhaust gases of internal combustion engines such as are used, more especially, on automobiles and other power driven vehicles.

"The object of my invention is the provision of a muffler which will serve to silently discharge the engine exhaust gases and with substantially no back pressure to lessen the efficiency of the engine."

Q. What other patents do you have bearing on this patent?

A. Gray patent No. 1,656,629.

In Figure 1 this patent shows an exhaust pipe and muffler of an automobile with the extreme end shown at the top of the figure in the form of a tapered exhaust pipe terminating in a curved outlet spout. The ratio
there is the square of the outlet and inlet ends of that
262 tapered portion, which would amount to about four
to one.

Q. How does the shape of the tapered portion of the Gray device compare with that of the defendant's device, as shown in Plaintiff's Exhibit 8 here?

A. It is quite similar.

Q. In what respect is it similar?

A. In that it has a large inlet end gradually tapering down to an almost straight tubular portion and then a tapered exhaust tip on the end of that, curved to one side.

I would like to recite one more that I thought was worthy of citation, which is the Stranahan patent No. 1,697,794, January 1, 1929.

That patent shows an exhaust pipe or muffler arrangement within which there is an exhaust pipe of depressed form with straight tapering walls. About nine to one would be the ratio of its inlet to its outlet extremities.

Q. Do you know the patents that were cited by the Examiner during the prosecution of the application resulting in Irgens patent No. 1,869,749?

A. The Perkins patent which I cited, Kemble No. 1,357,992, November 9, 1920.

263 The Court: : What is that?

A. The Kemble patent.

The Court: What about it?

A. It was cited by the Examiner.

The Court: You are not citing it?

A. We are not citing it.

Mr. Rummler: Q. Well, of those that you have mentioned that you are applying to claims 1 and 2, which, if any, are among those cited by the Examiner?

A. The Perkins patent is the only one.

Q. Referring now to claims 1 and 2 of the Irgens patent No. 1,869,749, will you read the claims?

A. Claim 1:

"The combination with a marine engine having an exhaust port, of a tapered exhaust pipe connected with said port and leading to a point beneath the surface of the water, said pipe having a submersible outlet movable in accordance with the operation of said engine and directed rearwardly with reference to its path of movement, whereby to eliminate back pressure from said pipe, the tapering form of said pipe being adapted to destroy its resonance to pulsation frequencies."

May I have the question?

(The question was read.)

A. Claim 2:

"The combination with a two-cycle, two cylinder engine

having exhaust ports, of a manifold member con-
264 nected with the respective ports, and an exhaust pipe leading from said manifold member and of such dimensions as to be resonant to the frequencies of pulsation occasioned therein by engine exhaust through said ports, said pipe having a tapered form destructive to said pulsations."

Q. Referring to the specification of the Irgens patent, do you find anything therein which indicates any relationship between the tapering form of the exhaust pipe and the frequencies of the exhaust pulsations?

A. On page 1, column 1, commencing in line 23:

"The principle objects of the invention are to increase the volume of the expansion chamber and to eliminate the pulsations which are set up in a straight exhaust pipe and which have a material effect on the power developed by the engine. This object is attained by tapering the pipe from the inlet end to the outlet end thereof, the inlet end being of larger cross-section than in the case of a straight pipe. It has been found by test that a pipe of this character eliminates the above mentioned pulsations and also increases the volume of the exhaust expansion chamber."

That is all I find that is pertinent to that point.

Q. Do you find anything in the specification that would lead one to determine what sizes of pipes or what degree of taper or what ratio of end area or areas of the tapered portion of the exhaust tubes should be used for any particular frequency of exhaust pulsation?

265 A. No.

Q. Do you find anything in the specification that will teach how to determine when you have a tapered exhaust tube that is destructive to the resonance to pulsation frequencies?

A. Nothing defined as such.

At the bottom of column 2 of page 1, there is given some dimensions. I will read that:

"The tube proper is a tapered member 10 extending from the center of the head 9 to the propeller shaft housing, as indicated by the numeral 11, and communicating with the mouth 7 of the plate 6 through a passage 5′ in the housing. The tube 10 tapers from the head 9 to the casing 5, or in the direction of flow, and the ratio of the upper end area to the lower end area may vary from 4:1 to 36:1. In a given construction, for example, the

upper end of the tube has a diameter of 4½ inches at the point 12 where it merges into the center of the head 9, and a diameter of 1-13/16 inches at the lower end."

Q. Do you find anything in the specification of this Irgens patent that would teach you how to build a tapered exhaust tube that would be destructive to the resonance to pulsation frequencies?

A. No, except these end dimensions. There is nothing said of the relation between the length and these dimensions.

Q. With the given limits for the ratio of the end
266 areas of four to one to thirty-six to one, is there anything in the specification that would teach you what ratio in between the end limits to adopt for any particular frequency of pulsation?

A. No.

Q. Is there anything in the specification of the Irgens patent that would teach you how long the tapered portion of the exhaust tube ought to be for any particular frequency of pulsations?

A. Not with respect to frequencies. The drawings show a uniformly tapered tube from its inlet end to its outlet end and the length is the height of the apparatus.

Q. When you say the height of the apparatus, what do you mean?

A. I mean the clear height between the engine and the point in the lower housing which the exhaust pipe enters.

Q. Referring now to the Arndt patent No. 1,875,912, which is here in suit—

The Court: What is the number?

Mr. Rummler: No. 1,875,912.

The Witness: September 6, 1932, Plaintiff's Exhibit 15.

267 Mr. Rummler: Claim 16 of this patent, your Honor, is the only claim in suit.

Q. What prior art patents, if any, do you find having a bearing on the subject matter of claim 16 of the Arndt patent?

A. Echard patent (French) No. 463,386, February 20, 1914, and Evinrude patent No. 1,567,127, December 27, 1925, and Pierce patent No. 1,579,834.

The Court: What is the second one?

A. The second one is Evinrude patent No. 1,567,127, December 27, 1925.

The Court: Echard is what?

Mr. Rummler: No. 463,386, French.

The Court: What is the other one?

A. Evinrude.

The Court: What is the Evinrude number?

A. 1,567,127.

The Court: Pierce is what?

A. 1,579,834.

Mr. Rummler: Q. Will you please read claim 16 of the Arndt patent?

A. Claim 16:

"In an outboard motor, a submersible unit having stream lined exterior surfaces converg-forwardly and includ-
268 ing a water passage having an inlet disposed at the forward apex of said surfaces within the zone of pressure created in the movement of said unit, the apex of said surfaces being linear in an upright direction and said inlet being transversely narrow and vertically elongated whereby pressures thereon will be approximately uniform throughout the area of said inlet."

Q. Now referring to the Echard patent No. 463,386, what bearing does the Echard disclosure have on this claim 16?

A. The inlet is at the front of the stream lined housing and the front edge of that housing is linear in an upright direction.

The Echard inlet is not shown in the face view. It is apparently a circular inlet.

Q. Is there anything in Figure 1 of the Echard drawing that would indicate that the leading edge of the under-water section, the propeller carrying member, is linear in an upright direction?

A. Yes, the right hand margin immediately above the propeller shaft, the right hand margin of the housing or casing is a straight vertical line and in Figure 1, which is the right hand figure in that chart, the section of that part of the housing is shown to be tapered at the front and tapered at the rear. It is an ordinary stream lined section.

269 The Evinrude patent I cite because it has an elongated inlet.

Mr. Wheeler: If the Court please, that Evinrude patent just referred to by the witness was not cited in the answer and I have not seen it. I don't know as I would have any objection to their referring to it to show the state of the art, but it is not cited as a reference.

The Witness: It is the patent that refers to that model you have, I think.

The Court: Where are the intakes?

Mr. Rummler: The intakes, your Honor, are in the rudder portion.

The Court: At 38?

Mr. Rummler: Q. The inlets there, are they are 38 in that drawing?

A. Yes.

The Court: Those are rods. The inlets are 6 and 7.

The Witness: Yes, the inlets 6 and 7.

In the patent the claim refers to a submersible unit with an inlet disposed at the forward apex of stream lined surfaces. The rudder is usually regarded as a stream lined surface. It is formed so as to produce as little resist-
270 ance to passage through the water as possible and that rudder is submersible, it has an inlet opening for a passage that extends vertically. The apex is linear in that it is brought to a fine edge and expanded at the point of those water passages to permit the larger hole to be formed there. Either of those inlets would answer this particular element of the claim, in my judgment.

Q. I show you a device marked for identification as Defendant's Exhibit B, which Mr. Irgens has identified as the stem of an Elto motor. Is this similar to or like the device shown in the drawing of the Evinrude patent you are now looking at?

A. Yes, it is apparently identical.

Q. Will you point out on this device where those inlets are that you have been talking about?

A. There is one inlet here and one here. This is the forward end of the rudder. This plate is brought down to a fine line and it is enlarged at this point, enlarged in a very smooth way. The ultimate of stream lining is a straight plane plus edgewise direction of its passage through the water.

This rudder has a planar body throughout the greater extent of its under-water area. That body is thickened
271 to permit the water inlet passage to flow through it at its rearward edge.

To my way of thinking it responds to the stream lined submerged structure.

Q. What bearing do the inlets shown in this rudder have on claim 16 of the Arndt patent?

A. The purpose of citing that is in connection with the

Echard patent, which shows the elements of the claim, except for the elongation of the inlet, and this Evinrude I cited to indicate that a vertically elongated and relatively narrow inlet is not new.

Mr. Wheeler: We have stipulated with the defense, your Honor, that this housing was a part of a motor produced by Elto in 1924.

Mr. Rummler: I would like to introduce this at this time then, as DEFENDANT'S EXHIBIT B, the stem or lower unit of the Elto motor.

The Court: It may be received.

(The exhibit was so marked.) 4

The Court: What do you say about that Evinrude patent not having been cited in the answer?

Mr. Rummler: The Evinrude patent, your Honor, I believe counsel is correct in that it was not cited in the answer.

This Evinrude patent we have just mentioned, your
272 Honor, is referred to more to indicate the state of the art than as a direct anticipation of what the art was doing.

The Court: Yes.

Mr. Rummler: Q. Now referring to Johnson No. 2,067,533, and particularly claims 1 and 2 of that patent, will you please read the claims?

The Court: Which is that?

Mr. Rummler: No. 2,067,533, Johnson.

The Witness: Plaintiff's Exhibit 16.

The Court: What is it, Johnson?

Mr. Rummler: Yes.

The Court: And the number?

Mr. Rummler: No. 2,067,533. That is the spark plug cover patent.

A. Claim 1:

"An internal combustion engine having an exposed spark plug, and a normally closed cover therefor hinged to the engine for making a tight connection with its outer surface and movable to cover and uncover the spark plug.

"2. The combination of an internal combustion engine having a projecting spark plug and connections thereto and a hinged normally closed cover therefor hinged to the engine for closing tightly against its outer surface and movable to cover and to uncover the spark plug and connections."

273 Q. Do you have any prior art patents that are pertinent to these claims 1 and 2 that we have just read?

A. Tripp patent No. 1,359,291, November 16, 1920. Rabezzana patent—

Q. Take these patents one at a time and discuss them.

The Court: No. 1,359,291. Yes, take them one at a time.

A. The Tripp patent shows an automobile, that is, it shows an automobile engine, an engine for motor driven vehicles in which the spark plugs are surrounded by a casing which has a hinged cover. In Figure 3 that cover is shown by dotted lines in a slightly open position, which is the position that the cover stands in when the engine is in operation. The cover closed down is shown in Figure 3 and serves the purpose, not only of covering the spark plug, but of cutting off the current.

Q. Do you know whether or not that Tripp patent was cited by the Examiner?

A. It is one of the patents cited by the Examiner as showing a hinged cover offering spark plug protection.

Another patent cited by the Examiner is that Rabezzana patent No. 1,806,548, and the date is May 19, 1931.

This patent shows shielding means for a spark plug
274 consisting of two hollow housing elements that are hinged together as shown in Figure 1. This is a protector for shielding the ignition apparatus. It is apparently designed for preventing radio waves from getting into the spark plugs, but it completely houses it.

Those two citations were made by the Examiner.

I find other art bearing on the subject named, Rice patent No. 1,733,361, October 29, 1929.

This patent shows in Figure 2, that is the second sheet, a hood enclosing the engine of an outboard motor and fitting over the spark plug. The spark plug is shown at 21. Over each spark plug there is a cover 26 which is removable for access to the spark plugs. It does not appear to be hinged.

Hult, et al., patent No. 1,146,427.

The Court: Where is that?

The Witness: Rice?

The Court: Yes.

A. It is in Figure 2. That is Rice patent No. 1,733,361, Figure 2.

The Court: You said 26?

A. Right under those handles that appear at the top. It is not shown just how it is, but it has a cover there.
275 It might be fastened in any well-known way, such as screwing or hinging or almost anything, but it is to give access to the spark plugs and yet to protect them from spray and exposure in other ways.

The Hult, et al., patent No. 1,146,427, July 13, 1915.

In Figure 1 of that patent, it shows an outboard motor with a hood over the engine. The hood is designated 6 in Figure 1 of the drawing and at the left-hand side, opposite the cylinder 1, is the spark plug, which again is covered by a cover. It is an incidental factor in this patent and is not shown as being screwed or how it is removed, but it would have to be removed in order to remove the cover so as to get access to the spark plug, which is, of course, frequently required. Therefore I presume that is a removable cover, not hinged.

Asbury patent No. 1,511,867, that was issued October 14, 1924.

This is also an outboard motor apparatus. In Figure 1, about in the middle of the view, will be seen the spark plug above the engine 10 and this spark plug is covered by a tubular shield closed at the top—through which a wire
276 enters. That shield is not numbered— Oh, yes, 50 is the number.

The Graybar catalogue, some sheets of which are bound in the rear of the binder of patents, shows numerous examples of electrical outlets and other connections protected by casings and provided with hinged covers covering the exposed parts of the electrical connections. In particular, on the first sheet the two views at the bottom of the sheet show two forms of this, one shows an outlet called a receptacle plug, where the hinged cover is open to allow the cord connection to be made.

The Court: What page is that on?

The Witness: It is away at the back of the book.

The Court: What page?

The Witness: It is the first page immediately following the title page. Oh, there is no title page.

Mr. Wheeler: Page 402?

A. It is page 402. There are two figures at the bottom of the page.

On page 404, the next succeeding page, is another angle receptacle, up in the upper right-hand corner, that has a

hinged cover provided with a snap for closing it and holding it closed.

On page 417, each of the views, except the one in
277 the lower right-hand corner, is a form of switch box or the like that is provided with a hinged cover.

On page 650 the three uppermost views also shows electrical housings with hinged covers.

Q. What bearing do these electrical outlet conduit boxes shown in the pages from the Graybar catalogue have on claims 1 and 2 of the Johnson patent No. 2,067,533?

A. They are analogous uses. They are not shown in connection with the internal combustion engine, but they are instances of analogy where electrical equipment like a spark plug is to be covered up and using a hinged cover.

Q. In the cases of those devices shown in the Graybar catalogue, where is the cover hinged?

A. It is hinged to the nearest part of the adjacent structure, like a housing. Certain of the other patents show the cover of the spark plugs of an outboard motor, but do not show the hinged relation, except the first mentioned Tripp patent shows the spark plugs covered by a hinged cover which protects them under all circumstances, except that it stands slightly open in the running condition.

Q. Do you know of any prior publication that has a
278 bearing on the question of well known and conventional forms of stream lining for under-water parts?

A. Yes, I am familiar with a great deal of that art, but would cite in that connection a Treatise on Hydraulics published in 1896, which was one of the textbooks that I studied at college. This shows the action of water around submerged, immersed bodies of various kinds, and discusses the subject in a general way.

Q. Referring to those publications and your experience, will you please tell what the state of the art was with regard to stream lining of under-water parts prior to 1920?

A. It was a very old art at that time. It was very well known what constituted good stream lining, and stream lining in general was understood to be refinement of the surfaces in order to avoid projections, and so forth, so as to make an easy flow of fluid that that surface was engaging.

The pear-shaped blunt-ended forward edge of the stream line section, with a long trailing rearwardly tapered edge was regarded as the best structure for under-water stream lining.

For water near the surface the pointed, pointed in both
directions, construction was generally regarded as the
279 best.

Q. You mean the knife-edge leading section?

A. Yes.

Q. And leading edge?

A. And the leading edge. The formation of the forward edge is not of so much importance as the long taper for the trailing edge. The forward edge should divide the oncoming filaments of water and near the surface, like is done in boats. Otherwise, they are frequently brought to a sharp edge, the sides of the stream lined sections.

I did not cite The Speed and Power of Ships, which is another reference that is shown here, that I think should be cited. It is taken from a book by Edward L. Atwood on Naval Architecture, published in 1919, which gives a description of stream lining for propellers. The example shown is a propeller with its propeller strut.

Q. Referring to The Speed and Power of Ships by Atwood, wherein does it describe what is a preferable stream line section?

A. Pages 124, 125 and the figures that accompany them,
those being Figures 1, 2, 4, 5 to 15, 16, 17 and 18 to 21,
that gives a theoretical discussion of the flow of water
280 about various sections of immersed bodies.

Q. Referring to page 125 of The Speed and Power of Ships, by D. W. Taylor, I believe I said Atwood before—Please read the second paragraph on page 125.

A. This is The Speed and Power of Ships, by D. W. Taylor, published in 1910, and the pages I referred to in the previous sentence were the pages of that publication.

What was this last question?

Q. Please read the second paragraph on page 125.

A. (Reading):

"As regards shape of section, model experiments indicate that a pear-shaped section, or a section of rounding forward part and sharp after part, offers the least resistance. Such a section may show model resistance as much as 10 per cent below the elliptical section."

The Court: What is the last part of that?

A. "Such a section may show model resistance as much as 10 per cent below the elliptical section."

What he means there is testing it as a model.

The Court: I understand that. But tell me what is the purpose of stream lining?

A. It is to prevent resistance to the passage of the object through the water or to prevent resistance to the flow of water past a stationary object.

281 The Court: From that viewpoint alone, is it preferable to have sharp edges front and rear or near the surface?

A. Yes.

The Court: Why?

A. It makes less waves than the blunt edge, which is better when it is deeper down in the water. The pear shape is a rather rounded blunt edge, whereas this sharp edge cuts the water.

The Court: I can see that too. What do the waves have to do with getting by?

A. It takes power to make waves. It throws the water and it is an effort to economize power.

The Court: I can't see it. You will have to explain that to me more carefully in order for me to get it. I can see that it will make more waves. I think I can, but just how that, from the standpoint of getting by, makes any particular difference, I cannot see, because you are by when the waves take place.

A. I don't think it makes a great deal of difference in an outboard motor structure.

The Court: What is that?

A. In an outboard motor structure, immediately behind the boat, I don't think stream lining in that

282 strut is so important as it may appear. It is a refined appearing structure, but whether or not there is a great deal of saving through that stream lining in those parts that follow the boat is quite a question in my mind.

Q. Explain the advantage of a sharp leading edge or a knife-edge?

The Court: He says it is to prevent waves.

Mr. Rummler: In comparison with the bow of a barge, for instance?

The Court: It is to prevent waves, he said.

Mr. Rummler: Q. How about the power consumption?

A. It takes power to make waves.

Q. So that if you had a smaller bow wave, would it require less power to move this body through the water than if you had a large bow wave?

A. Referring only to this body now?

Q. Yes.

A. The bow wave on this body?
Q. Yes.
A. Yes.
The Court: You say the round formed part makes more waves than the sharp?
Mr. Rummler: At the water level.
The Witness: At the water level.
283 The Court: Why wouldn't it do it down below?
A. There is the pressure of all the elements of water all around.
The Court: It does have that tendency?
A. It does have that tendency. It should separate the water, but it has been found by experience and experiments that the pear shape is best deep down under water.
It is shown in these drawings I called attention as being—
The Court: All right.
A. Those drawings show the filaments of water with various kinds of elliptical surfaces.
The Court: Are you concluding your direct now; are you just about to conclude your direct?
Mr. Rummler: Just about, your Honor. I would like to recall Mr. Fields for a few questions.
The Court: All right. Are you through with Mr. Rummler on direct?
Mr. Rummler: Yes, I am.
Mr. Wheeler: May we adjourn for a moment before I commence my cross?
The Court: Have you offered all of these patents?
Mr. Rummler: All of the patents in that book.
284 The Court: There are seventy.
Mr. Rummler: There are about twenty-three or twenty-four patents.
The Court: There are about seventy in here.
Mr. Rummler: Included with the patents that we are relying on, that book contains the prior art that was cited by the Examiner in the prosecution of those applications, as will appear from the certified copies of the file wrapper histories of these patents in suit, which I intend to file as exhibits. I have the certified copies here and some of them I want to refer to myself in argument, but I am going to file them all as defendant's exhibits.
The Court: We will take a short recess.
(A short recess was taken.)

285 *Cross-Examination by Mr. Wheeler.*

Q. Do you own an outboard motor yourself, Mr. Rummler?

A. No, I do not.

Q. Have you ever operated one?

A. Yes; not in recent years.

Q. Have you operated one that was provided with an anti-cavitation plate?

A. No.

Q. Do you know how that anti-cavitation plate should lie with reference to the horizontal?

A. Yes, I think it should lie level.

Q. It should be exactly horizontal, should it not?

A. According to my best judgment, yes.

Q. In this patent to Echard, the French patent, No. 463, 386, the strut or brace that overlies the propeller to hold the rudder, has a downward inclination to the rear, does it not?

A. Yes, it does.

Q. In your direct examination, when you referred to the British patent to Lanchester No. 14,792, you several times referred to the plate as an anti-cavitation plate.

Do you find anything in the specification of the

286 Lanchester patent that justifies your reference to this plate as an anti-cavitation plate?

A. It is not so described. The fact that it overlies the propeller would cause it to perform that function.

Q. What is the function of an anti-cavitation plate?

A. It is to prevent air from getting behind the propeller or getting mixed into the propeller blades and weakening its impact on the water.

Q. The purpose of the plate shown in the Lanchester patent is to keep the propeller from sinking too deeply into the water, is it not?

A. Yes.

Q. In other words, that plate acts like an aquaplane that glides over the surface and by gliding over the surface it supports the propeller?

A. Yes.

Q. Is it possible in your judgment, for a plate like that to glide over the surface at an angle such that it will have sufficient lift to support the propeller without at the same time entraining air that would pass beneath the plate?

A. No, there might be some air entrained beneath the plate.

Q. There certainly would be air, would there not?

287 A. Yes, there would be in the position it is shown with respect to the water.

Q. It has to operate at substantially that position in order to perform its function of supporting the propeller, does it not?

A. Yes.

Q. Will you please refer to the Cowles patent.

The Court: Did you refer to the Echard patent in your previous discussion?

Mr. Wheeler: I did not, your Honor. I mentioned the Echard patent, but I started discussing the Lanchester patent.

The Court: What did you say about it?

Mr. Wheeler: I brought out the fact that this brace which overlies the propeller carrying rudder has a downward inclination. It is inclined downwardly and rearwardly instead of being horizontal.

The Court: Has that been claimed to be a plate?

Mr. Wheeler: No, your Honor.

The Witness: It was cited by me as a reference for an anti-cavitation plate.

Mr. Wheeler: But it was not alleged to be a plate in and of itself.

The Court: All right.

288 Mr. Wheeler: What was the last question?

(The question was read as follows: "Will you please refer to the Cowles patent?")

The Witness: Will you give me the number of that, please?

The Court: No. 1,234,293.

Mr. Wheeler: Q. Figure 9 of that patent on sheet 4. Do you understand that that view represents a vertical axial section through the propeller shaft and the propeller shaft housing?

A. Yes, I do.

Q. Now when the device is in use, is that propeller shaft and propeller shaft housing horizontal, as shown in Figure 9, or does it have a downward inclination?

A. It has a downward inclination.

Q. If you take that structure as shown in Figure 9 and incline it downwardly to the rear, what happens with reference to the water inlet port, as shown at 130?

A. It lowers that slightly.
Q. It lowers it?
A. Yes.
Q. And it then becomes located behind the downwardly inclined shaft, does it not?
A. Yes.
289 Q. So that if you pull that shaft through the water at any speed, the shaft will tend to part the water, won't it?
A. Yes, to some extent.
Q. Well, if it parts it to any extent it may completely deprive that inlet of water, may it not?
A. I don't believe so, not as long as it is under water to the extent that the propeller can gain traction on the water.
Q. Even though it is behind the shaft and the shaft is parting the water, you still think the inlet will not be deprived of water?
A. No. The quantity of water going through might be reduced by reduction of this pressure, but certainly it would not be rendered inoperative as a water inlet.
Q. Will you please refer to the Ducassou patent No. 1,034,987.
A. Yes, I have it.
Q. I believe you testified that the stationary shaft housing *c* was stream lined throughout its height with sharp leading and trailing edges?
A. Yes, sir.
Q. Will you refer to Figure 1 of that patent and to Figure 4, the first and last views, and state whether
290 or not you find a water pipe extending up the rear margin of that housing?
A. Yes.
Q. Would that in any way modify the—
A. It is the front edge of the housing. Excuse me.
Q. At the front edge of the housing?
A. Yes.
Q. Would that in any way modify the answer you have given as to whether that housing has sharp fore and aft margins?
A. No, because that is a separate structure.
Q. It is fastened to it, isn't it?
A. Yes.
Q. So that it functions as a unit, does it not?
A. Yes, it functions as a unit.

Q. So that the presence of that water pipe would prevent that housing from functioning as a housing having a sharp leading edge, would it not?

A. I presume it would interfere with it some, but it would destroy its shape.

Q. It would act like a housing with a blunt leading edge throughout its height, wouldn't it?

A. To some extent.

Q. In Figure 1 of that patent, the rudder extends
291 to the water line, does it not?

A. Yes, sir.

Q. So that you could not aply an anti-cavitation plate to that housing without in some manner changing the construction, could you?

A. That is correct.

Q. Since that vertical shaft housing is stationary, and since the rudder turns with the propeller carrying casing for steering, what is the fact as to whether that rudder and that casing would interfere with each other so far as the formation of eddy currents is concerned?

A. That portion of the rudder that extends up along the housing, you mean?

Q. Yes.

A. I think it would make a conflict.

Q. The slightest turn of that rudder from a straight forward position would either drag the rudder or the housing sidewise through the water to some extent, wouldn't it?

A. Yes.

Q. What is the effect of an eddy current on cavitation; does it contribute to cavitation?

A. I should think it might.

Q. Don't you know from your hydraulic and
292 marine architectural experience that it does?

A. That is what cavitation is, it is eddying behind a propeller and behind a strut or over a propeller, all those things are called cavitation; any tendency to form a void is cavitation.

Q. Referring to the defendant's structure as exemplified in the physical exhibit 18 and in Exhibit 9, I call your attention to the fin that projects from the water inlet surfaces, and will ask you whether, if that fin were omitted from the structure, you would concede that at the level of the water inlet there was a streamlined contour with a blunt forward margin?

A. Yes, I would do that.

Q. What is the purpose for which the surfaces in which the water inlet holes are located are beveled with respect to each other; is that to minimize the resistance that would be offered if they were flat in the same plane?

A: I don't know the reason why that is done. It would have some of that tendency. I understand the purpose of the jog there is to provide a place for inlet openings.

Q. It is a fact, is it not, that despite the presence of that central fin the water reaching those inlets is
293 under pressure, due to the forward movement of the housing through the lake?

A. Yes, sir.

Q. The presence of that fin does not prevent the water from being under presure, then?

A. It does not destroy the pressure.

Q. Do you know what function that fin performs?

A. In what respect? It has a forward edge of a streamlined section.

Q. Why was it left there?

A. For appearance sake, to continue the straight forward edge of the structure, I presume.

Q. It has no mechanical function?

A. It would help contribute to the strength of the structure, but I do not know of any other mechanical function.

Q. Do you think it is necessary for strength?

A. No, there is ample strength there.

Q. Referring to Pierce patent No. 1,579,834. Do you have it?

A. Yes, sir; I have it.

Q. Is there anything in that drawing that indicates that the portion of Pierce cut away to provide space for the propeller blades to operate must be blunt?

294 A. Yes.

Q. What is it?

A. Figure 3 shows a vertical section and shows a width which, according to the other views, shows a variation in the thickness of that strut which widens out very largely through this part where this cut comes back. Consequently, in order to bring fair lines around for your stream lined section you would come to a rounded or a blunt front edge. You might possibly

have a sharp front edge, but it would be a very dull one.

Q. Regardless of width, it is possible, is it not, to come to a knife-edge?

A. By making the sides straight?

Q. Yes.

A. If you take fair curves, though, as are implied by a stream lined structure, which the upper views indicate the patentee was seeking, fair lines, and by fair lines I mean smooth lines, continuous lines, we switch in easy curves from one point to another. Those must come to almost a circle, the ellipse, when you are talking of the section there, the front part would be almost circular. It would be slightly elliptical, but more nearly circular than knife-edged.

295 Q. Regardless of how far apart the two sides may be at the point where they commence to converge, and even though they may have an elliptical form, they may still come together in a knife-edge as distinguished from a rounded or plain edge, may they not?

A. I think it would still be possible to form a knife-edge there. I am only surmising from experience in sections. When I see the tube used there it shows me that there is a very blunt side on the right hand side at that position.

Q. Now again looking at Figure 3, that is a front view, is it not?

A. Yes.

Q. And in that view the housing is shown immediately above the gear casing to have a width equal to that of the gear casing; isn't that correct?

A. Yes.

Q. So that is not a barrel-shaped gear casing, is it?

A. Yes, it is a barrel-shaped gear casing.

Q. How can it be barrel-shaped if the sides are parallel, as shown in Figure 3?

A. It is barrel-shaped at the ends and at all points where it merges into the stream lining. The lines are not drawn—By barrel-shape do you mean perfectly

296 cylindrical? I have not construed it so.

Q. It has a cylindrical nose, doesn't it?

A. Yes.

Q. Or rather a conical nose with a cylindrical base?

A. Yes.

Q. And back of that, so far as you can determine

from Figure 3, it has perfectly parallel sides, doesn't it?

A. No. If you will take the line 2, which represents the front edge of that, you will see that line runs right down straight and meets the cylindrical portion of that propeller barrel and it is supposedly stream lined throughout its height. That would mean that this stream lining would gradually merge from the stream lined form to the elongated form of the barrel. There would be a filament or a fillet in there that would bring that in, but so far as these drawings show it is sharp-edged.

Q. So far as the center of the gear casing is concerned, that does have vertical parallel walls?

A. Oh, yes; yes, indeed.

Q. Where would you say that the water line would be in a device of this character?

A. Somewhere above the propeller. I would agree
297 with Mr. Irgens that it might be between lines 16 and 18, or somewhere in that vicinity.

Q. You can tell that from the drawing and from your experience in naval architecture?

A. Yes, I would say that that would be where it would be.

Q. There is no showing in this drawing of a rudder, is there?

A. No, sir.

Q. In other words, there is nothing illustrated behind the propeller and nothing connected to the part that you call a strut and which is used for steering?

A. No.

Q. Regarding the Johnson patent in suit, No. 1,763,970, you testified, I believe, that as you interpreted claim 17 it called for a blunt edge going all the way to a water level; is that correct?

A. Yes. Were you talking about claim 17?

Mr. Wheeler: Claim 14—What was it?

The Court: Claim 14.

The Witness: Claim 14.

Mr. Wheeler: Q. Is that your intepretation of claim 14?

A. Yes, that would be my normal interpretation
298 of the expression, "that portion below the normal water level having its front edge of bluntly rounded stream line contour with a trailing edge of substantially knife-edged stream line construction."

Q. But as you referred to the drawings of this patent I believe you also conceded that the patent does not show a construction in which the blunt section is carried above the anti-cavitation plate; is that correct?

A. Yes, that is correct.

Q. So that if that claim is to be interpreted to read on the drawings of the patent in which it is found, it cannot mean that the blunt section must go clear to the water line, can it?

A. Well, I construe it to mean that portion. I am taking the language as it stands, that portion that lies below the water line, and I understand that all that portion that is above the anti-cavitation plate is sharp-edged.

Q. In other words, if you interpret the claim to read on the drawings of the patent in which the claim is found, the claim cannot mean the blunt portion must go clear to the water line, can it?

A. It says so.

Q. Is it customary to interpret a patent claim in

299 the light of the disclosure of the patent?

Yes.

Q. If you interpret that in accordance with the disclosure of the patent, you cannot interpret it to require that blunt section to go clear to the water line, can you?

A. To meet the terms of that claim, you must. I don't think that claim without construction means going clear to the water line, or anything about going clear to the water line.

Q. Do you think it is proper to interpret a patent claim so as to exclude the device on which it is based, the disclosure on which it is based?

A. Yes; in determining the validity of that claim I think it is a question of whether the applicant had a right to make it or not.

Q. Should a claim be interpreted to make it void or to preserve its validity?

A. To preserve it, if possible.

Q. Now if you will please refer to the Evinrude patent in suit No. 1,786,835. In Figure 3 there is an opening at 26 through which the vertical drive shaft 10 passes through the top of the chamber in which the pump impeller is located; is that correct?

300 A. Yes.

Q. There is also an opening in the horizontal parti-

tion 28 which constitutes part of the anti-cavitation plate and through that opening also the propeller shaft extends, does it not?

A. Yes.

Q. In Plaintiff's Exhibit 8, which is the stipulated drawing of defendant's 16-horse power construction, there is also at the top of the lower portion of the lower unit a horizontal plate, which I shall label X, and which is provided with an opening through which the vertical drive shaft extends; is that correct?

A. Yes, sir.

Q. Above the impeller, there is also an opening at Y, is there not?

A. There is a cavity there.

Q. And below that cavity the impeller is fitted to the metal which overlies it, is it not?

A. No, it is not in the actual structure. This drawing is slightly erroneous in that respect.

Q. In the actual structure, you claim there is a variance between that and the drawing?

A. Yes, in two respects. In the view of the top of the housing, which shows the rotor in there, the drafts-
301 man has shown the impeller contacting with a seat in
the structure, that is where you have marked the Y in the structure that carries the spider above there, that carries that bearing for the impeller, it is shown as a tight fit. I am informed that there is considerable clearance there. There is not a rubbing fit at all.

Q. Apart from the question as to a rubbing fit, which is not what I asked you, it is a fact, is it not, that the rotor disk fits into a shoulder, whether it is in contact or not, it is fitted to the overlying metal structure which encloses the cavity at Y; is that not correct?

A. I can't say as to that.

Q. Well, it is shown in the stipulated drawing, isn't it?

A. Yes, it is shown in the stipulated drawing.

Q. Now then, with that device in operation, regardless of any close fit, there would be no possibility of water escaping through the cavity Y, would there?

A. No, unless there is leakage of the bearings, but the intent is to stop the water there.

Q. My question was independent of anything to do with the bearing. In other words, if you have an impeller rotating within a channel or shoulder, it would be impossi-
302 ble for water to leak past it even without a close fit at

that point, would it not? You certainly would not have any water under pressure going upwardly along that shaft?

A. No, you would not.

Q. And the shaft extends through the cavity Y, does it not?

A. Yes.

Q. The Mandl patent (German) No. 345,103, to which you have referred, was a file wrapper reference, was it not?

A. Yes, with respect to which patent?

Q. As against this Evinrude pump patent No. 1,786,835?

A. No.

Mr. Rummler: Yes.

The Witness: Yes, it was. Yes.

Mr. Wheeler: Q. Have you found any prior art patent that shows a centrifugal impeller or any other kind of an impeller located on the vertical drive shaft and disposed in a cavity formed between two sections of a lower unit?

A. Yes, the Mandl patent does that.

Q. Where does that Mandl patent have its inlet, in the upper section or the lower section?

303 A. In the upper section.

Q. Do you regard that shaft housing in the Mandl patent as being a part of the lower unit in that patent?

A. Yes, it could be just as well as not.

Q. It is not, in the sense in which we have the two sections formed in Plaintiff's Exhibit 8, is it?

A. It is not surrounded by a second housing, if that is what you mean.

Q. Well, referring to Figure 8, you have a shaft housing at Z, do you not?

A. Yes.

Q. And that shaft housing is secured to an upper section A of a lower unit, is it not?

A. If you refer to that enlarged part there as the lower unit, yes, that would be it.

Q. And the section A of the lower unit is, in turn, screwed to a section B of the lower unit, is it not?

A. Yes.

Q. So that the shaft housing Z is distinguished in that construction from the lower unit, which comprises sections A and B?

A. The shaft housing in its entirety includes that lower

unit, as well as the upper unit. It is simply made up of
304 a number of sections. That shaft housing runs
throughout the whole length of that shaft.

Q. Are you familiar with the way the term lower unit is used in the outboard industry?

A. No, I am not.

Q. Would you say that it was intended to include a shaft housing such as that shown at Z, this tubular shaft housing?

A. No; if I were referring to a lower unit or upper unit I would call the Z the upper unit and the rest of it the lower unit.

Q. Now referring to Mandle No. 345,103, the German patent, upon which you have relied, all of the part below the impeller chamber *u* is gear casing in that patent, isn't it?

A. Yes.

Q. Do you suppose that probably accounts for the fact that the inlet into the impeller chamber is from above?

A. Yes, I would.

Q. The inlet in that patent does not surround the shaft, does it?

A. No.

Q. Now will you please refer to the Pierce reference No. 1,579,834.

A. Yes, I have it.

305 Q. How do you get access to the gear casing to
place or remove gears from that?

A. The housing is split on a horizontal line through the propeller shaft so that the two parts separate. There is a lower part 9 that drops down from the remainder that gives access both to the pump and the propeller gears.

Q. In that patent also the inlet to the impeller chamber comes from the upper section, does it not?

A. Yes.

Q. Are you familiar with displacement pumps such as are constituted by means of a piston operating in a cylinder?

A. Yes.

Q. When such a pump is in operation does the piston have any physical contact with the wall of the cylinder?

A. A rubbing contact.

Q. Do you think it has?

A. Are you talking about the film that lubricates it?

Q. I am; yes.

A. Yes. Well, there is a film that lubricates the piston.

Q. If there were not, it would soon wear away to a point where there would not be contact, wouldn't it?

306 A. Yes.

Q. So that wherever two metallic parts move with respect to each other there must be a film intervening, must there not?

A. Yes.

Q. Now in discussing this Evinrude patent in suit No. 1,786,835, and particularly claim 8, you made the statement, if I recall correctly, that it is common in the art to have a stream lined housing with the pump chamber in its wider portion at an intermediate level. Where do you find that in the art?

A. In the Echard patent.

Q. In Echard, referring to Figure 1, there appears at y^1 a horizontal section of that lower unit, does there not?

A. Yes, sir.

Q. Is the pump chamber shown in its proper relationship to that section?

A. Yes, I think so.

Q. Do you think the pump chamber is located at the widest part of that section?

A. No.

Q. Then I repeat my former question as to where in the art you find a stream lined housing with a pump

307 chamber in its widest portion at an intermediate level?

A. That pump chamber is rearward of the knife-edge and the portion is wider there than at that point there (indicating), at that part which lies in front of it, it is in the widest portion.

Q. What is in the widest portion?

A. The shaft, the main shaft, the drive shaft.

Q. I call your attention to the limitation in claim 8 as specifying that a water passage is formed in the housing below the chamber.

A. Yes, sir.

Q. And leading centrally thereto, and a delivery passage is formed above the chamber between the rearwardly converging walls of the housing. Do you find that structure in Echard?

A. No, I regard that merely as words without any inventive significance.

Q. But you do not find it?

A. I do not find it.

Q. The claim further calls for a centrifugal pump runner mounted on the vertical drive shaft. Is that true of Echard?

The Witness: Will you please repeat that question?

Q. Do you find in Echard a centrifugal pump run-
308 ner mounted on the shaft within the chamber?

A. No.

Q. Now if you did have in Echard a centrifugal pump runner mounted on the vertical drive shaft, it could not be in a chamber that was located forwardly of the widest portion, could it?

A. No.

Q. Because the shaft is in the widest portion.

A. It would have to be in the widest portion.

Q. So that in interpreting that language specifying that the pump chamber is in the wider portion of the housing, it presumably refers to the widest portion of the housing, doesn't it?

A. It could narrowly, but I think it would not necessarily have to be there.

Q. It must, if it is going to be mounted on the vertical drive shaft, mustn't it?

A. The vertical drive shaft must not necessarily be in the widest portion. It is a matter of choice of stream lining.

Q. Would you make the exhaust or lower unit any wider than was necessary to enclose the drive shaft?

A. No.

Q. So the drive shaft would probably be at the
309 widest portion, wouldn't it?

A. It probably would.

Q. With respect to claim 9 of that same Evinrude patent No. 1,786,835, you stated, if I recall correctly, that this was completely met, in your opinion, by Mandl and Smith. Do you find in either Mandl or Smith, or elsewhere, a lower unit that is made to comprise sections that are severable at the level of the anti-cavitation plate?

A. I was talking of essentials, Mr. Wheeler.

Q. You do not regard the claim as met in terms?

A. No, it is not met in terms.

Q. Now in the Evinrude patent in question, No. 1,786,835, in Figure 7 the impeller is mounted in a chamber for which space is provided by the enlargement shown at C on this chart; is that not correct?

A. Yes.

Q. Referring to defendant's construction as exemplified in Plaintiff's Exhibit 8, there is an enlargement at D which provides space for a pump chamber containing the impeller, does it not?

A. Depends on what you are calling an enlargement. It is an enlargement of the shaft housing, yes, to accommodate that pump, but the point under discussion
310 was the enlargement of the anti-cavitation plate.

Q. Without reference to what it is an enlargement of, in each instance you do have an enlargement?

A. A housing.

Q. A housing there.

A. Yes, it is an enlargement of something; yes.

Q. In each instance the anti-cavitation plate projects laterally beyond that housing, doesn't it?

A. Yes.

Q. In each instance the anti-cavitation plate forms the bottom of that housing, doesn't it?

A. Yes.

Q. Suppose there were no anti-cavitation plate there at all, it would be necessary to provide a bottom for that housing, wouldn't it?

A. Yes.

Q. That bottom would have to have substantially the same thickness as the thickness now provided in that structure, wouldn't it?

A. Yes.

Q. In that event, the movement of the housing through the water would have a predetermined resistence based on its width and thickness and form, wouldn't it?

A. Yes.

311 Q. Now then, in the construction shown in the defendant's device, Plaintiff's Exhibit 8, the combined thickness of the housing at D and the anti-cavitation plate is just equal, as I understood your testimony, to what the housing would have without the anti-cavitation plate; is that correct?

A. Well, I should say it would be approximately equal to that. I don't know whether that is exactly correct, but it is near enough for the purpose, I think.

Q. So that by reason of the association of the housing with the anti-cavitation plate, you are accommodating the thickness of the anti-cavitation plate with no materially greater resistence to travel through the water

than you would have from the housing alone, are you not?

A. Almost the same, I would say.

Q. What portion of an anti-cavitation plate performs the function of exclusing vortices or eddies from the propeller to prevent cavitation?

A. All of it.

Q. In the device shown in the Evinrude patent No. 1,786,835, does the area represented by the chamber which I have marked C on the chart, contribute to the exclusion of air from the propeller?

A. I would say not if C refers to that housing

312 member C that encloses the impeller and not to the flange that is at the bottom of it.

Q. I am referring to the housing portion which I have marked C. Is it not a fact that no other anti-cavitation structure is exposed to the water which flows over that plate?

A. I ask you again what you mean by C. Does it include those flanges?

Q. No.

A. I think it would not contribute to the anti-cavitation.

Q. If air is moved downwardly along the lower unit adjacent the part 15 in the direction I have indicated by the arrow in Figure 7, such air being unobstructed would cause cavitation, wouldn't it?

A. If air is flowing there; yes.

Q. What intercepts that air, referring to Figure 7 of Evinrude No. 1,786,835?

A. If air flowed in that place that chamber would serve to intercept or deflect it outwardly, to some extent.

Q. Wouldn't it serve entirely to obstruct it; there is nothing there, is there?

A. No, it would run over this surface and proceed on downward.

313 Q. But that chamber and its flange together are the full width of the anti-cavitation plate, are they not?

A. Yes.

Q. So that in so far as air tending to move downwardly along that housing is obstructed at all, it is obstructed by the top surface of the chamber C, is it not, and the flange?

A. It would be deflected by that; yes; it would not be stopped.

Q. In so far as it is obstructed at all, it is obstructed by that chamber and flange; is that correct?

A. Yes.

Q. So that so far as that portion of the device next to the top section of the lower unit is concerned, the pump chamber serves the whole function of the anti-cavitation plate, does it not?

A. So far as that immediate area is concerned; yes.

Q. Now referring to the defendant's structure as indicated in Plaintiff's Exhibit 8, if there is any air moving downwardly, as indicated by the arrow in the view at the right of this chart, that air also will be met and obstructed to some degree at the top of the pump housing, won't it?

A. If you have a condition where that air moves
314 downwardly like that, yes.

Q. Isn't that condition what the anti-cavitation plate is supposed to meet?

A. No.

Q. What condition is it supposed to meet?

A. It is supposed to meet a condition where the thrust, the rearward thrust of the propeller deprives or draws water from the surface and lowers the water surface so as to allow air to get into the slip-stream or on the propeller path, and that is due to air flowing somewhat longitudinally, I should say, not a direct downward flow down that shaft.

Q. You mean, then no anti-cavitation plate is needed along the sides of the housing at all?

A. Under certain conditions, not. It is a matter of speed.

Q. Why does defendant use it, then?

A. Because it has been well known and it is found to be a fact that cavitation does take place over the propeller and that the anti-cavitation plate in an outboard motor will serve that function.

Q. In this particular structure that function is served at that point toward which the arrow is directed at the top of the pump chamber, is it not?

315 I do not regard that as a fact. I regard the anti-cavitation plate as being submerged and having a flow of water over it. In certain instances, there might be cases where it would come out of the water, but my

understanding of it is that it does not receive the impact of air such as is indicated by the arrow in that sketch.

Q. Whether it is air or water that you understand to be moving downwardly, whatever it is that the anti-cavitation plate resists, is it not a fact that at that point in the defendant's structure the air or water encounters, not the plate proper, but the pump chamber?

A. Yes, if air could flow like that and if it could be shown that air could flow like that, the pump chamber might serve that, but I can't see that.

Q. I am saying if air or water, or whatever you understand it to be, flowed downwardly—

A. I understand this thing, if I may explain, as moving rapidly through the water.

Q. Yes.

A. And through the air, all air currents and all water currents are traveling at right angles to what that arrow shows, and I do not conceive of any such downward air currents.

316 Q. You do not understand that there are any eddies that might be formed here that will flow down along there?

A. Surely, eddies form there.

Q. Are those eddies not, in so far as they trend to create vortices, interrupted by the pump chamber D in the defendant's structure?

A. No, they are met by it.

I want to be helpful, Mr. Wheeler, but I just can't see that point that is in your mind.

Q. If you removed the pump chamber D from the structure shown in Defendant's Exhibit A, would the underlying portion of the anti-cavitation plate be useful?

A. Yes. You mean if you took the pump chamber off of the anti-cavitation plate?

Q. Yes.

A. Yes, it certainly would.

Q. The portion underlying the chamber would be useful?

A. Yes.

Q. Is that same utility performed by the top surface of the pump chamber when the pump chamber covers that part of the anti-cavitation plate?

A. There are times when that portion of the anti-cavitation plate would be performing an important func-

tion, and there are times when it might not. As to
317 that pump chamber, the upper surface of it would take the place of that part of the anti-cavitation plate that would be intercepted by anything that flowed there, but beyond that I cannot follow your point.
318 Q. In referring to the Irgens patent in suit No. 1,869,749, on the tapered exhaust pipe, I believe you mentioned that the Perkins patent No. 1,131,862 was a file wrapper reference. Do you regard the Miller patent No. 1,073,920 as being closer to the structure of the claims than Perkins?

A. No. I cited those references because of the under-water exhaust, the extremity of the under-water exhaust pipe, mainly, the fact that it is under water.

Q. One is as essential as the other, so far as your testimony is concerned?

A. Yes.

Q. The Hardy patent and the Patch patent, the Gray patent and the Stranahan patent, to which you have
319 referred, all relate solely to mufflers, do they not?

Q. Those mufflers as disclosed are not used in conjunction with under-water exhausts, are they?

A. To the best of my recollection, they are not. I do not wish to take the time to look at those patents unless you wish me to take the time.

Q. I am going to refer to them, anyway. I will call your attention to Hardy No. 1,169,030.

A. Yes.

Q. Does that show any connection to an under-water exhaust?

A. No.

Q. That exhausts directly into the open air?

A. Yes.

Q. These cones shown inside of that muffler are used, are they, to alternately expand and contract the gases, to muffle sound?

A. Yes.

Q. I will now refer to Patch patent No. 1,357,079.

A. Yes, I recall that.

Q. Do you find in the Patch patent any indication that that device is used as a tube to connect a muffler with the under-water exhaust?

A. No, it is not.

320 Q. That device is completely flat, as viewed in Figure 2, is it not?

A. Yes.
Q. Are the tapered baffles used within that flat casing employed to muffle sound waves?
A. Yes.
Q. I now refer you to the patent to Gray No. 1,656,629.
A. Yes, I have it.
Q. Is that device a muffler in and of itself, or does it constitute a type of a muffler with an under-water exhaust?
A. It is not shown in connection with an under-water exhaust. It is shown in connection with a muffler arrangement, a series of muffling devices.
Q. Which view in that patent do you regard as being pertinent to the questions here in issue?
A. Figure 1 and Figure 2, particularly. There are numerous tapers in there, but I cite those in particular.
Q. What is Figure 2, a section through Figure 1?
A. No, Figure 2 is an outside view, side elevation, similar to Figure 1.
Q. Is Figure 3 a section of Figure 2?
A. It is a section of part of Figure 2. It shows
321 the tapered tube part, yes.
Q. How does the gas escape from the device as shown in Figure 2; does it not escape through the tube at 4?
A. Yes.
Q. In other words, the gas does not pass through the tapered external casing at all, does it?
A. Not at this point, no.
Q. In other words, that part 7 of that casing is merely an expansion chamber for the gas from which it must leave through the small holes at 5 and issue through the tube 4?
A. Yes, that is correct.
Q. Will you now refer to the Stranahan patent No. 1,697,794.
A. Yes.
Q. That patent also is not a patent in which there is any under-water exhaust, is it?
A. No.
Q. It exhausts into the open air?
A. It is just an internal combustion engine with an exhaust to the open air.
Q. And the tapered cones 15 and 16 are both perforated, are they not?
A. Yes.

322 Q. And they both constitute baffles for the gas which passes through the perforations in these cones, as well as through the cones themselves; is that correct?

A. By that you mean that the gases pass through these openings, as well as through the tubes?

Q. Yes.

A. Yes, that is true.

Q. Did you have any tools furnished you with the outboard motor that you have operated?

A. No.

Q. Did you ever have a spark plug foul which you had to remove to clean?

A. I have had it happen on an automobile a great deal, but I never had it on an outboard motor.

I think I said, Mr. Wheeler, that I have not practiced the operation of an outboard motor to such an extent as to qualify as an expert in that regard. My qualifications are a knowledge of the general art.

Q. Yes. Will you please refer to the patent in suit, Johnson No. 2,067,533 on the spark plug cover?

A. Yes, I have it.

Q. That spark plug that is shown there has a metallic base that is squared up by the application of a wrench
323 in the removal of the plug, is it not?

A. Yes.

Q. And beyond that is a porcelain piece through which the electrode runs to the outer end of the plug?

A. Yes.

Q. So that in applying a wrench to that plug, unless you happen to have a socket wrench, your wrench would project at right angles to the plug and close to the base, wouldn't it?

A. Yes.

Q. The cover as provided in this device seats against the engine in such a way that when the cover is open it exposes that flat sided portion of the spark plug to receive the wrench, does it not?

A. Yes.

Q. Now will you please refer to the patent to Tripp No. 1,359,291?

A. I have it.

Q. The cover to which you referred in that patent is a flat plate 11, is it not?

A. Yes.

Q. And that cover is normally open rather than closed during operation?

A. Yes.

324 Q. Now assuming that you open that cover wide, you still would have the housing 10 completely surrounding the spark plugs, wouldn't you?

A. Yes.

Q. So that the cover does not close with reference to the engine at all, does it?

A. No. You mean closing on the engine?

Q. It is not closed on or even near the engine. It closes against the housing 10.

A. Yes, that is right.

Q. Will you refer to the patent to Rabezzana No. 1,806,548?

A. Yes.

Q. In that patent also it is a fact, is it not, that the housing does not close at or near the engine?

A. The hinge, you mean the hinge of the housing, or do you mean the edge of the housing?

Q. Whatever the cover is, it does not close against or near the engine cylinder?

A. It closes on the nut of the spark plug.

Q. Of the spark plug itself?

A. Yes.

Q. So the base of the plug is fully exposed to weather and salt water, as far as that device is concerned?

325 A. As far as that device is concerned.

Q. Now will you refer to the Rice patent No. 1,733,361?

A. Yes.

Q. In that device, I believe you called attention in your direct examination to the cover 25 in Figure 2.

A. Yes.

Q. That cover closes an opening in a permanent shield 25, does it not?

A. Yes.

Q. So that the cover does not seat against or operate in conjunction with the engine cylinder, does it?

A. That is true.

Q. I will now refer you to the Hult patent No. 1,146,427. I believe you mentioned in that connection Figure 1 of the Hult patent and the dome-shaped closure that apparently is recessed to provide room for the spark plug.

A. Will you please repeat the Hult number?

Q. It is No. 1,146,427.

A. Yes. Will you please ask the question again?

Q. You referred, I believe, to the dome-shaped closure shown in Figure 1?

A. Yes.

Q. Beyond the end of the spark plug?

A. Yes, that is correct.

326 Q. And that closure also does not seat or close against the engine cylinder 1, does it?

A. No.

Q. It simply closes an opening in an external shield?

A. That is right.

Q. Will you refer now to the Asbury patent No. 1,511,867?

A. Yes.

Q. You referred in that patent to Figure 1 and the cover that is over the spark plug?

A. Yes.

Q. Do you think that cover is so designed as to be adapted for removal to make repairs or to clean the plug while the device is on the boat?

A. I wouldn't say you could do it while it is on the boat, because it is under the water line.

Q. It is a permanent part of the engine structure. Is it not necessary to the successful operation of that engine?

A. Oh, yes.

Q. So that that engine does not have what could be characterized as an exposed plug at any time, regardless of any cover, does it?

A. Not when it is in operating condition.

327 Q. No. In your reference to the Graybar catalogue, the devices shown on page 402, those devices are also devices in general where some kind of a cover plate seats against a housing, are they not?

A. Yes, in each case.

Q. Now then, as to all of the devices shown in the Tripp and the Rabezzana and the Hult and Asbury patents, is it not a fact that as to those if your cover is not made to close with reference to the engine block itself you cannot get access to the plug for removing it in accordance with the objectives of the patent in suit No. 2,067,533?

A. The opening must be adjacent or close to the engine surface, yes, if that is what I understand you to mean.

Q. Yes, and that is not true of any of those reference devices, is it?

A. Well, those reference devices, when they are re-

moved or when they are open they give access to the spark plug.

Q. But they give access to a casing instead of giving access to the plug next to the engine cylinder, don't they?

A. Yes, but—

Q. They give access to the end of the plug rather
328 to the portion to which you apply a wrench, don't they?

A. One does not remove a spark plug with an ordinary wrench. You would break the porcelain if you did that. I always use a socket wrench when I remove a spark plug.

Q. But assuming you do not have a socket wrench with you, since you are operating an outboard motor, and you want to remove the plug, you could not do so with the devices of these references, could you?

A. Not with most of them. With the Patch reference we show the removable housing. I would take that whole housing off and then use an ordinary wrench.

Q. You would have to take the whole housing off?

A. You would have to take the whole housing off that encloses the spark plugs and is screwed at the lower end. That is the Asbury patent, I mean.

Q. But that you could not do on the water, as you testified?

A. You would have to raise the outboard motor; that is removable if the water line happened to be at the point at which it is shown here, shown just about at the lower edge of the spark plug. I do not regard the water line as a constant factor.

Q. If you were leaning over the back end of the
329 boat, trying to do something, your weight would cause the water line to be considerably higher than if you were sitting in the seat?

A. Unless you had somebody in the other end to counteract your weight. If it were under water, I certainly would do that.

Q. Do you think that Asbury was intending that to be done in that manner, or would suggest that to anybody?

A. Mr. Wheeler, when a man is aboard ship and some emergency happens, they generally figure out some way of taking care of it. I presume if this motor was put into practical use it doubtless could be handled in some way.

Q. What is that object shown at 39, that drum-shaped object?

A. I take that to be the tank, I can take the time to

look in the specification if that is not a satisfactory answer.

Q. I agree with you, but the point I would like to make is this, if you lift the housing for removing it, it would contact the bottom of the tank, wouldn't it?

A. That depends on the position. This is an elevation that shows all those things side by side. They may be quite some distance at the side of this tank. Undoubt-
330 edly the tank would be placed so as to leave access to that spark plug. The wire seems to run straight up. It would be a tube design if it were in the tank.

Q. So far as it is shown there, there is less space between the housing and the tank than there is in the overlap in the housing of the end cylinder?

A. In this elevation, yes.

Q. At the conclusion of your testimony yesterday, you referred to a number of treatises or publications on hydraulics, and, if I understood you correctly, you said it is now well known that a body moving through the water should have a sharply pointed stream lined section at and near the surface and a blunt front edge well below the surface. Do you find anything in those publications that draws that distinction?

A. I did not intend to imply that it was well known to always use those to particular forms. I simply meant that all of those forms of stream lining were well known, many long in the art, and that in my judgment the sharp edge close to the surface was better than the blunt edge close to the surface, and the blunt edge below the surface was better than the sharp edge below the surface.

331 Q. I understood your testimony to that effect, but I am asking you whether there is anything in the publications or patents that you have cited which in any manner suggests that you should draw that differentiation and use a sharp stream line at the surface and the blunt stream line below, in the same structure?

A. Yes, there is.

Q. All right. Where is it?

A. In the Theoretical Naval Architecture publication, page 250, there is a treatise there on that page and the next page, showing the bluntly rounded front edge of the stream lined section for struts that carry the barrels in which the propeller shaft is mounted, and he says there at the bottom of page 250:

"The length of the arms or struts must necessarily de-

pend on the position of the axis of the shaft at the bracket and the shape of the ship in the vicinity. The section of the arms is usually pear-shaped (see Figs. 85G and 108 for examples), with the blunt end forward. The dimensions of the section must be governed by the straining action to which the bracket is subjected. Formerly these dimensions appear to have been determined in a rough-and-ready way from the experience of the designer responsible. Knowing the dimensions in previous cases which on service had proved sufficiently strong, he would vary these dimensions in a new ship according to the variation of the horse power,"

I am skipping a little.

332 "Consequently it will be found that ships of about the same size, horse power and revolutions produced under different designers, have entirely different dimensions (and weights) of shaft brackets."

Have I gone on far enough to answer your question? That is very complete.

Q. My question was whether you found in any publication any suggestion that you should use two different forms of stream lining in the same object, according to whether you were dealing with a portion of that object that was close to the surface or a portion that was well submerged?

A. Stated in that way, I would say no. May I answer a little more?

The forward end of ships, at the point where they travel along the water, of course, is made sharp in many instances. In some instances it is made so as to direct the water downward, but when it is desirable to direct the water sidewise, there is a sharp edge there to prevent wave motions.

Q. As I understood your testimony, you simply referred to these publications in a general sort of a way to indicate that stream lining was an old art; is that correct?

A. That is correct.

333 Mr. Wheeler: I am through now, Mr. Rummler.

Redirect Examination by Mr. Rummler.

Q. During your cross-examination, in reference to the Pierce Reissue patent No. 18,118, you mentioned a location for the water line as being approximately between the numerals 16 and 18. Is there anything in the Pierce specification that would lead you to that conclusion, or is

there anything in the Pierce specification that would tell where the water line might possibly be?

A. No. Then that water line, if it were between the numerals 16 and 18, would be approximately six inches above the propeller, assuming that the propeller was a 7-inch propeller, would it not?

A. It would be. According to the dimensions, it would be about, oh, a third of the span of the propeller blades.

The Court: Above the upper edge or at the center line of the propeller, or at its highest position?

A. Yes.

Mr. Rummler: Q. However, from anything that is said in the specification, that water line might well be
334 one foot or a foot and one half above the center line of the propeller, might it not?

A. Yes.

Q. With reference to cavitation in an outboard motor, as shown by the operation of the propeller, what is the nature of that cavitation?

A. It is a depression in the water surface, due to the action of the propeller. It might be roughly defined as a vortex.

Q. Where does that vortex ordinarily occur?

A. Over the propeller.

Q. What happens when such a vortex does occur?

A. Well, if the depression gets low enough so that the tips of the propeller can come out, it would tend to draw air in there and reduce the efficiency of the propeller.

Q. If the anti-cavitation plate were to be applied to obviate this cavitation or vortex, where would you place that plate?

A. Immediately above the propeller.

Q. I would like you to refer to the textbook of Theoretical Naval Architecture that you were talking about when Mr. Wheeler finished his cross-examination, and referring to page 310, I wish you would read what
335 is said in the first paragraph.

A. (Reading):

"Now we have to pass from this hypothetical case to the case of a vessel on the surface of the water. In this case the water surface is free, and the excess of pressure at the bow and stern shows itself by an elevation of the water at the bow and stern, and the decrease of pressure along the sides shows itself by a depression of the water

along the sides. This system is shown by the dotted profile of the water surface in Fig. 110, which has been termed the statical wave. The foregoing gives us the reason for the wave-crest at the stern of the ship. The crest at the bow appears quite a reasonable thing to expect, but the crest at the stern is due to the same set of causes. This disturbance of level at the bow and stern is described by Mr. R. E. Froude as the 'forcive' of the actual wave formation. If a stone is thrown in the water, the sudden disturbance propogates a series of waves that radiate in all directions. In the case of a ship, the shape of the ship causes the disturbance to form diverging and transverse waves as seen below."

Q. The forcive or bow wave that is pushed ahead of the boat, what is the nature of that wave?

A. It is a wave that is thrown away from the bow.

Q. Then that leads to the conclusion, does it not, that the sharper the bow the less would be this bow wave that is pushed ahead of the boat?

Mr. Wheeler: Objected to as leading.

The Court: Yes, it is leading. But he may answer.

A. Yes.

336 Mr. Rummler: That is all.

Mr. Wheeler: I have no further cross-examination.

Mr. Rummler: I would like to recall Mr. Fields.

CLESENT O. FIELDS, recalled as a witness on behalf of defendants, having been previously sworn, testified as follows:

Direct Examination by Mr. Rummler.

Q. Mr. Fields, with reference to the pump shown in Plaintiff's Exhibit 8, the 16-horsepower motor of the defendants, what are the clearances that are maintained between the backing plate or disk of the pump impeller and the upper wall of the pump chamber?

A. The clearance is from two thousandths to seventeen thousandths.

Q. Can you convert that to fractions of an inch?

A. Seventeen thousandths is just two thousandths over a sixty-fourth of an inch.

Q. How is that clearance maintained, Mr. Fields?

A. That clearance is maintained by the support of the

shaft on the bracket which you find in the gear housing just above the propeller shaft and above the impeller
337 on the bushing that projects down from it.

Q. From what?

A. The bushing that projects down and contacts the top of the impeller.

Q. Contacts the upwardly projecting hub of the propeller?

A. That is correct.

Q. What clearance is maintained in the defendant's devices between the ends of the impeller blades and the peripheral wall of the pump housing?

A. That clearance is a minimum of eight and a half thousandths, a maximum of eleven thousandths.

Q. In the fractions of an inch, that would be about what?

A. That is four thousandths less than a sixty-fourth on a maximum dimension.

Q. In the manufacture of defendant's motors, is that clearance that you have mentioned for both the periphery of the impeller and between the back plate and the upper wall of the pump chamber always maintained?

A. It is. The bushing is definitely pressed in with the fixture to hold a definite relation between these and the base of the housing that it sets in, and the impeller is held on the shaft at a definite dimension
338 in order to hold it within these limits.

Q. Why is that done, Mr. Fields?

A. That is done to prevent a contact with the housing itself, which would result in wear.

Q. Mr. Fields, does water ever reach the space that is indicated by Y on this Plaintiff's Exhibit 8 when the device is in operation?

A. It does.

Q. How do you know that?

A. Simply from the fact that in actual operation of these motors we have found that at any time the bushing wears, that is, above the impeller, to over four thousandths of an inch clearance over the drive shaft, that water will immediately go up into the housing above that with sufficient pressure even to strike the lower end of the crank shaft.

Q. So that there is actually sufficient pressure at the periphery of the impeller to force water up above

the impeller when the device is in operation; is that true?

A. Yes, when this device is operated I have stated that there is sufficient pressure to force this water up past that bearing to the position at the lower end of the crank shaft.

339 Q. Does the back plate of the impeller serve in any way to prevent this water from going up above the impeller?

A. In a minor way, yes, it would, but it is not a definite block to the water.

Q. So that you couldn't say that that plate closes off that space above the propeller or the passage, could you?

A. It doesn't.

Q. Mr. Fields, does the pump housing indicated by the letter D, on Plaintiff's Exhibit 8, cause any turbulence that would in any way interfere with the purpose and function of the anti-cavitation plate?

A. It does cause turbulence, even at low speeds, although the turbulence there is minor to what it is at high speeds.

Back in our early construction of that motor, we had a certain width of anti-cavitation plate on the stem and had to increase this plate in order to overcome the trouble caused by the turbulence around that housing at D.

Q. Would the device be more efficient, as far as the stream lining is concerned, if the pump housing were omitted?

340 A. It definitely would.

Q. What is the nature of this disturbance that is caused by the pump housing above the anti-cavitation plate?

A. It breaks the water, the solidity of the water, due to its large width, that causes this water to leave a void above the plate.

Q. Then would you say that the pump housing in any way assisted the anti-cavitation plate in its purpose and function?

A. It does not assist it.

Q. Referring to the lower portion, and particularly the water inlet located at B on Plaintiff's Exhibit 8, the rib that separates the areas for the inlet openings on defendant's device, is that a continuation of the frontal edge or apex of the stream lined surfaces directly above the rear of the inlets?

A. It is.

Q. Mr. Fields, was there any reason for bringing that rib down as a continuation of this apex rather than cutting it out entirely and leaving a perfectly flat opening all the way across the front edge of the underwater part at the inlets?

A. Several reasons for its being designed in that
341 manner. First, that straight forward edge there, without any means of weeds catching on it, will shed the weeds much better than if that was set back in. You have the rib leading on the forward edge and with the water relieved of some of the pressure which is back of it at the inlet holes, according to stream line tests, flow tests, that gives us the same results as the housing just above it, which is substantially knife-edged.

Regarding the water holes, they were set back from the face in order to be able to get this thing without disturbing that stream line.

Also, the slight angularity of these holes—

Q. Just a minute, Mr. Fields. I hand you a device marked for identification as Defendant's Exhibit E, which is the lower unit of the device illustrated in Plaintiff's Exhibit 8, and I wish that you would point to the elements that you are talking about as you explain this.

A. The slight angularity of these holes back from this rib are so drilled in order to make them cut in at an angle so that the drill when breaking through the casting does not drag along one side, which would cause considerable drill breakage.

342 The easiest way to drill those holes, if it were not for that feature, would have been to drill them straight down parallel to the rib itself, but in order to get rid of this drill breakage we have angled those holes in at a fifteen-degree angle, which causes them to direct it to the inside of the casting at a degree at which they get a very good clearance.

Q. Is that the reason for giving this backward slope to the surface in which the inlet openings are drilled?

A. That is correct. In other words, the backward slope is then at right angles to the approaching drill.

Q. Does the rib extending along the leading edge of the device and between the areas of the inlet openings have any other function than to aid in preserving the stream lined characteristics of the surfaces?

A. I can see none other, of course, than the aforementioned idea of shedding weeds on the lower stem.

Q. What would happen if you had a perfectly flat inlet opening without the rib, as far as weeds are concerned?

A. The weeds would hang up at this portion here and trail back and interfere with the performance of the propeller.

Q. And would the weeds lie against and perhaps close the inlet opening entirely if the rib were omitted?

343 A. That is correct.

Mr. Rummler: I believe that is all, Mr. Fields. Perhaps at this time I should introduce all of the exhibits that I want to put in:

I will introduce DEFENDANT'S EXHIBIT C, the stem and upper housing of a No. 9 motor built by the defendant, including the mounting bearing, the drive shaft and impeller.

(The exhibit was so marked.)

I introduce as DEFENDANT'S EXHIBIT D a specimen of the skeg or lower housing of defendant's No. 9 motor.

(The exhibit was so marked.)

I introduce as DEFENDANT'S EXHIBIT E the skeg or lower housing of defendant's 16-horse power motor.

(The exhibit was so marked.)

The Court: You referred to a No. 9 motor. Did you mean the 9-horse power motor?

Mr. Rummler: The 9-horse power motor, yes, your Honor, and this Defendant's Exhibit E is the 16-horse power motor.

I introduce as DEFENDANT'S EXHIBIT F the upper housing member of defendant's 16-horse power motor.

(The exhibit was so marked.)

344 I also introduce as DEFENDANT'S EXHIBIT G a muffler or exhaust tube for defendant's 16-horse power motor.

(The exhibit was so marked.)

I introduce as DEFENDANT'S EXHIBIT I a certified copy of the file wrapper and contents of plaintiff's patent No. 1,716,962.

(The exhibit was so marked.)

As DEFENDANT'S EXHIBIT J, I introduce a certified copy of the file wrapper and contents of plaintiff's patent No. 1,763,970.

(The exhibit was so marked.)

As DEFENDANT'S EXHIBIT K, I introduce a certified copy of the file wrapper and contents of plaintiff's patent No. 1,786,835.

(The exhibit was so marked.)

As DEFENDANT'S EXHIBIT L, I introduce a certified copy of the file wrapper and contents of plaintiff's Reissue patent No. 18,118.

(The exhibit was so marked.)

As DEFENDANT'S EXHIBIT M, I introduce a certified copy of the file wrapper and contents of plaintiff's patent No. 1,869,749.

(The exhibit was so marked.)

As DEFENDANT'S EXHIBIT N, I introduce a
345 certified copy of file wrapper and contents of plaintiff's patent No. 1,875,912.

(The exhibit was so marked.)

As Defendant's Exhibit O, I introduce defendant's working drawing for the lower stem adapter.

(The exhibit was so marked.)

As DEFENDANT'S EXHIBIT P, I introduce defendant's working drawing of the gear housing.

(The exhibit was so marked.)

Defendant's Exhibits O and P are both drawings of the 9-horse power motor.

As DEFENDANT'S EXHIBIT Q, I introduce defendant's working drawing showing the lower stem adapter for the 16-horse power motor.

(The exhibit was so marked.)

As DEFENDANT'S EXHIBIT R, I introduce defendant's working drawing showing the gear housing for defendant's 16-horse power motor.

(The exhibit was so marked.)

As DEFENDANT'S EXHIBIT S, I introduce defendant's working drawing showing the clearances maintained between the pump impeller and the pump housing, both at its top and at its periphery.

(The exhibit was so marked.)

346 The Court: Supposing we take a short recess, gentlemen.

(A short recess was taken.)

Cross-Examination by Mr. Wheeler.

Q. Is it true of defendant's 9-horse power motor, as shown in Plaintiff's Exhibit 5, that it, as well as the 16-horse power motor shown in Plaintiff's Exhibit 8, has a cavity above the impeller?

A. That is true.

Q. Does the impeller have approximately the same clearances with respect to the top of the pump chamber below that cavity in the 9-horse power as in the 16-horse power?

A. It does. There is only approximately a thousandth or two greater clearance in the 9-horse power than there is in the 16-horse power.

Q. Is it true of each of those motors that in the bottom of the pump chamber there is a water inlet through which the drive shaft extends?

A. That is true.

Q. You testified, I believe, that you designed the
347 9-horse power motor, as shown in Plaintiff's Exhibit 5?

A. That is correct.

Q. But that you did not design the 16-horse power motor, as shown in Plaintiff's Exhibit 8?

A. That is correct.

Mr. Wheeler: If your Honor please, I move to strike the witness' testimony on direct-examination as to the purposes for which the 16-horse power motor was designed. He didn't even design it himself, and I don't believe he is competent to testify as to the purposes.

The Court: The motion may be entered. You may discuss it in the argument.

Mr. Wheeler: Q. Can you tell by looking at Plaintiff's Exhibits 17 and 18, the actual physical motors of the defendant, approximately when those motors were made?

A. I would say that both of those motors were made in 1938.

Q. In each of those motors the exhaust pipe extends down well behind the pump housing, doesn't it?

A. The 9-horse power is not below the pump housing.

Q. I said well behind the pump housing.

A. Well behind the pump housing, that is correct.

Q. There are several inches between the pump
348 housing and the exhaust pipe where the exhaust pipe enters the water?

A. Repeat that question again.

Q. It is a matter of several inches between the pump housing and the exhaust pipe at the point where the exhaust pipe enters the water?

A. That is true on the 9-horse power. There is only approximately a half inch between on the 16-horse power.

Q. A half an inch between what surfaces, where does the exhaust pipe enter the water on the 16-horse power?

A. Any place between six inches of the drum and the end of the pipe.

Q. Will you refer to Plaintiff's Exhibit 8 and mark on the drawing what clearance you meant when you referred to a half-inch?

A. This clearance right in there.

Q. The clearance to which I have drawn an arrow and marked with the reference character F?

A. That is correct.

Q. Now the question is, how much clearance is there between the pump chamber and the exhaust pipe?

A. By pump chamber you are speaking of the recess that the pump seats in?

Q. Yes.

349 A. There is another question that comes to me before I can answer that correctly. You mean this tapered portion or do you mean this straight line drawn down from that part?

Q. What is the clearance at the point which I have designated by the reference character G on Plaintiff's Exhibit 8?

A. Close to an inch.

Q. Is the part of the exhaust pipe at that point of minimum clearance operating in the water normally?

A. I would say definitely that about ninety per cent of the time that is in the water.

Q. Suppose you left out the impeller completely but preserved the form of the chamber shown at D in Plaintiff's Exhibit 8, would there be any difference in the operation of the device dependent on whether the impeller was in or out, so far as its stream lined construction is concerned in moving through the water?

A. Yes, there would be.

Q. How so?

A. Because the disturbance of water would not go directly over the plate; it would come above the plate to the height that the muffler is above the plate, and be farther back.

350 Q. I don't believe you understood my question. I asked you whether, if you preserved the chamber at D and took the impeller out of it, there would be any difference?

A. There would not be.

Q. If you made the anti-cavitation plate of the identical form and dimensions of the plate and the chamber D, would it function in exactly the same manner that it does now, regardless of whether it had an impeller in it or not?

A. That is correct.

Q. You said that the pump chamber was a detriment. Is it any more of a detriment by reason of its being combined with the anti-cavitation plate, or is it less?

A. It has no bearing on it, whether it is fastened to it or whether it is cast integrally, or whether it is fastened on with screws, it is still the same detriment.

Q. Supposing you had no anti-cavitation plate on this model at all, but did have a pump, a pump chamber at that level, your pump chamber would then be thicker than your present pump chamber, because it would be necessary to replace the anti-cavitation wall with a bottom plate for the pump chamber, would it not?

351 A. If we used an anti-cavitation plate with that, it would be; yes.

Q. My question was, suppose you had no anti-cavitation plate at all, you would then have to replace the plate with a bottom wall for the pump chamber, wouldn't you?

A. That is correct.

Q. So your pump chamber would then be thicker than it is in your present construction if you discard the plate; is that correct?

A. That is correct.

Q. Now if you had a pump chamber at one level and a cavitation plate at a different level, you would then have two objects to disturb the water instead of one, wouldn't you?

A. That is right.

Q. So that by combining them in the form shown in the drawing, you do reduce the amount of disturbance that would be occasioned if you had both the plate and the pump chamber at different levels?

A. That is correct.

Mr. Wheeler: That is all.

Mr. Rummler: Defendant rests.

Defendants rest.

352 Thereupon the plaintiffs, further to maintain the issues on their behalf, introduced the following evidence in rebuttal, to wit:

FINN T. IRGENS, recalled as a witness on behalf of the plaintiffs, having been previously sworn, testified in rebuttal as follows:

Direct Examination by Mr. Wheeler.

Q. Have you operated a boat equipped with defendant's outboard motors here in controversy?
A. Yes, I have.
Q. Which one?
A. The 9-horse power.
Q. Do you know whether the lower unit of the defendant's 9-horse power motor effects a steering operation of the boat after the motor is cut off?
A. Yes, it does.
Q. What is your experience with respect to the movement of a boat through the water after the power has been shut off from the outboard motor on the boat?
A. The boat will coast along after the power is
353 shut off.
Q. Will you elaborate your answer to describe the effect on boats of different constructions?
A. A displacement boat is a boat with a round bottom and designed to carry a relatively heavy load. That would coast for quite a distance before it would come to a stop.
A planing boat, that is, a boat that is very light and travels on the top of the surface, that would travel for a distance after the power was shut off and then it would sink in the water in order to obtain buoyancy. That would come to rest very fast.
Q. Approximately how far, on a boat of the kind with which defendant's 9-horse power would normally be used?
A. Oh, it could amount to thirty, thirty-five or forty feet.
Q. What is the ordinary length of a boat with which a 9-horse power motor could be used?
A. The common length of a boat like that would run about fourteen to sixteen feet.

Q. Would you consider it safe to operate such a boat at full speed to within twenty feet of a dock before cutting off the power?

A. No, I think that would be very unsafe.

354 Q. Is it your experience in general stream line lower units such as those shown, for example, in the Johnson patent in suit No. 1,716,962, or No. 1,763,970, or in Pierce Reissue patent No. 18,118, that they are, in fact, used for steering a boat to the dock after the power is cut off?

A. They are.

Q. How far would a displacement boat tend to run on the average after the power it cut off if the boat had been operated with a 9-horse power motor?

A. Well, if the boat is not fair lined and relatively heavily loaded, it could travel at least fifty feet.

Q. How fast does such a boat operate when under full power?

A. A displacement boat with a 9-horse power motor would not run more than eight or nine miles an hour.

Q. How fast would a planing boat operate with a 9-horse power motor under normal conditions?

A. A motor of that type should be able to run twenty-five or thirty miles an hour.

Q. Will you please give the same approximate figures for the 16-horse power motor?

A. A 16-horse power motor should run better than thirty miles an hour.

355 Q. On what kind of a boat?

A. On a planing boat.

Q. And on a displacement boat?

A. On a displacement boat it would not go more than approximately ten miles per hour.

Q. With reference to your patent on the tapered exhaust No. 1,869,749, will you please state whether the tests that you described when you were formerly on the stand were conducted in a tank or on a boat in open water?

A. Those tests were conducted on a boat traveling.

Q. Why?

A. Well, you cannot obtain satisfactory results in any test of that nature in a tank where the water is stationary.

Q. Why is that true?

A. Well, the water rushes past the exhaust outlet

when the motor is in operation on the boat and it creates a suction on the exhaust.

Q. In a tank does the propeller set the water in operation to provide a slip-stream?

A. Yes.

Q. Does the effect of such a slip-stream compare with
the movement of the device through the water when
356 it is attached to a boat?

A. The propeller slip-stream is below the exhaust outlet and won't have any effect on that.

Q. What is the fact as to whether, in making those tests on the Lockwood motor, about which you testified in your former appearance on the stand, you had an opportunity to compare them with previous tank tests?

A. Yes. We run all of our motors in tanks for running in, so that all motors are run in tanks. We have had quite a bit of experience with tank tests, but to obtain results in regard in exhaust back pressures, those cannot be obtained in a tank.

Q. Did you test the motor on which you originally discovered the need for a tapered exhaust pipe in a tank while that motor still had a straight exhaust pipe and before it was tested in open water?

A. Yes.

Q. With the straight exhaust pipe, did the tests of that motor conform to what you had expected as a result of the tank test?

A. Do you mean running the motor with a straight pipe in the tank or in the lake?

Q. I mean did the results obtained in the lake with
the straight pipe comply with what you had ex-
357 pected as a result of your tank test with the straight
pipe?

A. No, you cannot draw any comparison between tests like that. The results are entirely different.

Q. Does this matter of resonant pulsations in the exhaust pipe have any relation to sound pulsations?

A. They are entirely different. You can have a pressure wave; that would not be a sound wave.

Q. Were the waves which your tapered exhaust pipe was designed to counteract audible waves?

A. No, those are pressure waves. As far as the noise is concerned, that is taken care of by the under-water exhaust. We are not concerned with that.

Q. Can you gauge the presence or absence of those detrimental pressure waves by listening to the sound of the exhaust under any circumstances?

A. No.

Q. With what type of boat is a motor with a stream lined lower unit ordinarily employed?

A. With a relatively fast boat. That is the purpose of stream lining.

Q. What is a relatively fast boat in terms of the kind of hull that is employed?

A. We consider fast boats any boat that will ride
on the top of the surface and you can plane a boat
358 from fifteen miles up to seventy miles an hour. That
is done with outboard motors.

Q. What kind of an under-surface do such boats ordinarily have?

A. They are principally flat in order to provide a carrying surface.

Q. Now behind such a boat is the water encountered by the lower unit of the outboard motor in a turbulent condition due to the passage of the boat?

A. There is hardly any turbulence behind the boat. The water leaves in a flat sheet.

Q. Will you please refer to Plaintiff's Exhibit 8 and by drawing lines thereon, or otherwise, explain how cavitation occurs and why it occurs and where the air tends to reach the propeller?

A. Well, the water line must be approximately along that line (indicating).

Q. Why?

A. It has ~~to be~~ in the stream line section of the gear housing and the exhaust must be submerged because it is an under-water exhaust. Now the principal reason for propeller cavitation in an outboard motor is the partition of the water at the gear housing or drive
housing. In other wards, air is sucked down along
359 lines like that (indicating).

Q. What causes that cavitation?

A. That is air being sucked into the propeller.

Q. Why is air sucked into the propeller? Will you please go over that again?

A. There is naturally a suction in front of the propeller because the propeller is driving and the gear housing and drive housing will split the water as the boat goes through the water, and there might be a suc-

tion along the sides of the housing due to the splitting of the water, and that suction will form a vortex, a cavity, through which air can be sucked down into the propeller stream.

Q. What relation does the shape of the anti-cavitation plate have to the point at which air is apt to be sucked down along the gear housing to reach the propeller?

A. The anti-cavitation plate is always placed where you would have cavitation if it were not there.

Q. Why is the anti-cavitation plate extended forwardly of the gear housing?

A. In some housings it is necessary to carry the anti-cavitation plate forward of the housing in order to prevent cavitation.

360 Q. Why is the anti-cavitation plate carried along the sides of the gear housing?

A. For the same reason. It is necessary to have it there.

Q. Why is the anti-cavitation plate in Plaintiff's Exhibit 8 extended beneath the exhaust pipe?

A. I would say that in that particular design it is to prevent the exhaust from being sucked down into the propeller.

Q. The exhaust is issuing from the end of that pipe just above the level of the anti-cavitation plate, as shown in Plaintiff's Exhibit 8?

A. That is correct.

Q. Have you known instances where the anti-cavitation plate might be located wholly forwardly of the propeller?

A. Yes. We have manufactured motors like that ourselves.

Q. In so far as the pump chamber D in Plaintiff's Exhibit 8 is mounted on top of the anti-cavitation plate, is it located in the path of the air which might otherwise tend to reach the propeller?

A. Yes.

Q. What would you say as to whether the form

361 of the defendant's lower units, as shown, for example, in Plaintiff's Exhibit 9, with particular reference to the level at which the water intake is located, operates to give the defendant's motor the advantage of a blunted stream line in that section?

A. It does perform the function of a blunted stream line housing.

Q. Will you please explain that?

A. The housing is flattened at the point where the water intake is and in that respect it would form a blunt housing.

Q. Is the water intake in that motor under pressure or not?

A. It is under pressure.

Q. What would be the fact if the water intake were located an equal distance behind the unnotched and uniform sharp-edged stream line which I am marking with the reference character M on Plaintiff's Exhibit 9?

A. At that point you might encounter suction.

Q. Will you please explain why?

A. Because the water has already been split or parted by the housing.

Q. What is the zone of pressure and what is the zone of depression in such a housing as it moves through

362 the water?

A. The zone of pressure would be toward the front edge.

Q. What would exist along the sides of such a housing?

A. Depending on the shape of the housing, the degree of stream lining, you may have suction along the sides of the housing.

Q. Is it your understanding that this rib which devides the two rows of water ports in defendant's structure prevents the ports from being under pressure?

A. No, I do not think it does.

Q. I will hand you a blue print marked L-5, and ask if you can identify the drawing shown on that print?

A. Yes, I have seen that before.

Q. When did you see it?

A. I saw it when the drawing was originally marked in the Johnson Engineering office.

Q. What were you doing at the time?

A. I worked as Mr. Johnson's assistant in the Johnson engineering department.

Q. Which Mr. Johnson?

A. I worked as Mr. Louis Johnson's assistant.

Q. Who made this drawing at the time you saw it?

A. Mr. Harry Johnson made the drawing.

363 Q. Does it show a stream lined section housing?

A. It does.

Q. That serves as a gear casing?

A. It does.

Q. Was it intended to have any shafts in it, and if so, where?

A. It was intended to have a vertical drive shaft coming down through the center of the vertical section and that was geared to a horizontal propeller shaft running along a horizontal center line.

Q. Did it have a plate intermediate the top and bottom of the stream lined section?

A. Yes, it did.

Q. Will you please point that out?

A. The plate is running along here.

Q. Would that plate tend to prevent cavitation to the propeller?

A. Yes.

Q. Now when was the time when you first saw this drawing, to your recollection?

A. Well, the drawing is marked as being drawn on May 23, 1924, and at that time I was working in the engineering department of Johnson.

Q. When did you see it with reference to that date?

364 A. I saw it prior to that date because the motor was laid out, there was a general layout made of the complete motor before the detail was made.

Q. Is that the general practice of Johnson Motor Company?

A. Yes.

Q. Please describe that practice a little more specifically for making a general layout first?

A. First a general layout is made of the whole idea of the motor, getting all the relative sizes of the different constituent parts, and after that layout is made the individual parts are detailed.

This drawing is a blue print from a tracing that was made from one of those, of a drawing that was made from one of the parts.

Q. In other words, this drawing followed the general layout in which those parts would be used?

A. That is right.

Q. Do your initials appear on this drawing?

A. Yes, my initials appear in the column for chief draftsman.

Q. When were those placed on there?

A. This is dated June 17, 1924.

Q. When did you place your initials on there?

365 A. On that date.

Q. You put the initials on yourself, and the date, in your own handwriting?

A. Yes.

Q. But you testified, as I understand it, that you had seen the drawing before that time?

A. Yes, I saw the drawing before and I saw the drawing being made.

Mr. Wheeler: I offer this drawing in evidence as PLAINTIFF'S EXHIBIT 19.

(The exhibit was so marked.)

That is all of the direct.

Cross-Examination by Mr. Rummler.

Q. Mr. Irgens, in testifying about the speed of travel of a displacement boat and a planing boat, you said that with a 9-horse power motor driving a displacement boat you would have a speed of eight or nine miles per hour?

A. Yes.

Q. And with a 9-horse power motor driving a planing boat you would have a speed of twenty-five to thirty miles per hour?

366 A. Yes.

Q. What sized boat did you have in mind?

A. Well, a regular displacement boat for that type of motor will run between fourteen and sixteen feet in length. A planing boat is considerably shorter. They can run to down to ten or twelve feet, even shorter than that.

Q. You then referred to a 16-horse power motor as driving a displacement boat about ten miles an hour and a planing boat at better than thirty miles an hour. now what boat did you have in mind when you were talking about a 16-horse power motor?

A. A 16-horse power motor of the type shown here would be usable on a boat, let us say, sixteen to eighteen feet in length, and planing boats, they can run from twelve to fourteen feet.

Q. Mr. Irgens, what is it that determines the horse power or size of motor that will be put on any particular boat?

A. Depending on how fast you want to go.

Q. So that with a fourteen foot boat you could use a 5-horse power motor or a 9-horse power motor, or a

16-horse power motor, or even higher if you could get it?

367 A. Yes.

Q. It depends on how fast you want to go?

A. Depends on how fast you want to go and the load.

Q. And with a 9-horse power motor, or for that matter, with a 16-horse power motor, you could put it on the back of a ten-foot dinghy?

A. Not a 16-horse power, not even a 9-horse power, would fit in a dinghy. The dinghies are short and small and I think it would be absolutely improper.

Q. Have you ever seen that used on a dinghy?

A. No, I have not.

Mr. Rummler: I have.

The Witness: Not that sized boat. If you did it, you should not have done it.

Q. Why?

A. It is not the right motor for that type of boat. You can get much better performance with a smaller one.

Q. Is it your idea that the type of motor you are going to use on a certain boat is more or less left to the choice of the operator?

A. Yes, we choose some of the motors.

Q. What is it that influences a purchaser in the size of motor that he is going to buy?

A. What he expects to get out of the motor. If he
368 has a fast boat in mind he should buy a motor that will drive that boat at a fast clip.

Q. Would you say the price of the motor had anything to do with that, due to the fact that the 16-horse power motor costs considerably more than the 9-horse power motor?

A. A man might not be able to afford to go fast.

Q. With reference to the test that you conducted on your exhaust tube, while you were conducting the original test on which you finally chose a tube, were any pressure indicating instruments used to determine what pressures you were getting in the exhaust tube and at the outlet?

A. No, we used no instruments at that time. We ran tests on boats on the lake, and when we finally ended up with a design we were able to run an under-water exhaust and they gave us no power loss. In other words, we could run the motor with an under-water exhaust just as fast as we could by taking the whole muffler system off. That was quite an accomplishment.

Q. You arrived at that conclusion or learned that fact out on the lake, didn't you, without the use of testing instruments?

A. Yes; I told you that before.

369 Q. It was only after you had determined on a certain tapered shape that you made tests with pressure recording instruments or pressure indicating instruments?

A. As a matter of fact, we never ran any pressure recording tests on the muffler at all, but it is common knowledge that in straight pipes you can get pressure waves traveling from one end of the pipe to the other.

Q. But in the case of the tests for the tapered tube that you adopted, you just experimented and cut-and-tried until you found one that filled the bill?

A. That is correct.

Q. In discussing the action of the propeller in causing cavitation, Mr. Irgens, you said that the propeller sucks water from in front of the propeller. Now is that exactly the fact, or does the propeller tend to pass through the water like a screw would in a solid body?

A. Well, the water is not solid. The propeller is displacing water and when it displaces water in front of itself there is going to be a suction there.

Q. You mean that as water moves out other water will move in?

A. Yes.

Q. But isn't that somewhat determined by the 370 pitch of the propeller blades?

A. The degree is determined by that, but there must be suction there if you have driving effort.

Q. This suction caused by the propeller in displacing water and attempting to screw itself through the water as though it were a solid body, causes water to flow in from in front of the propeller, doesn't it?

A. Yes.

Q. And does not cause air to flow down from the top, necessarily?

A. It causes water to flow in toward the propeller. If you haven't got enough water or can't supply it fast enough, you are going to have a cavity and air is going to be sucked down into it.

Q. In locating an anti-cavitation plate, which you have said is generally old and was known before John-

son, or before 1924, let us say, where would you put it?

A. I would put it where I would expect air to go down into the propeller stream.

Q. So from observation you would determine where air would be likely to go down into the propeller stream and then set the anti-cavitation plate in the path of that air stream?

371 A. From observation and tests I would find out where the air would go down.

Q. Now also, in referring to the inlet openings, that is, the water inlet openings of defendant's device, you stated that if the openings were made as holes in this stream lined surface indicated by M and about at the point where this line terminates, there would be suction?

A. No, I didn't say that. I said there might be suction.

Q. You said there might be suction?

A. Yes.

Q. Under what conditions would there be suction and under what conditions would there not be suction?

A. If the stream line is made of such a shape that the water is split or parted relatively then you would have suction there.

Q. Referring to Plaintiff's Exhibit 8, would you say that the stream line indicated by this section, that is, the second from the bottom, would you say that that is of such shape as to split the water and not result in suction at the sides here, which would correspond to this position indicated by M on Plaintiff's Exhibit 9?

A. You ask me a general question. If you drive it 372 fast enough you will get that.

Q. About how fast would you have to go to get that?

A. I cannot tell by looking at the cross-section. We have made housings of similar shapes that have had suction at that particular point.

Q. Mr. Irgens, what motor is this?

A. That is what is known as the Elto Speedy Twin.

Q. Is this a current model of motor, Mr. Irgens?

A. It is, as far as the mechanical parts are concerned. It is current. It is changed in appearance at the present time, it has a different muffler on it and a different exhaust pipe, but generally it is like the motor you see.

Q. Now Mr. Irgens, I am referring to the under-water part of this motor between the anti-cavitation plate and

the barrel-like portion for the propeller shaft, and it shows an inlet that is substantially rectangular in shape and extends in a plane that is at right angles to the fore and aft axis of the propeller shaft and which is located at the apex of the converging surfaces of the side walls of this under-water section and directly above that inlet there are some openings in the sides of the unit which apparently lead into the water passage; do they?

373 A. That is correct, and leading into the water passage.

Q. Those openings are located at approximately the point indicated by M on Plaintiff's Exhibit 9?

A. That is correct.

Q. With this motor driving at its normal cruising speed, would there be any suction at these upper inlets in the side surface?

A. There could be.

Q. If there were suction in those openings, how would that affect the flow of water up the water passage leading to the pump?

A. It would affect it very little because the main water intake is down below and of greater cross-section, and at the high speeds of our motors it will give much too much cooling water, due to the characteristics of a centrifugal pump.

Q. Mr. Irgens, do you know what the purpose of those holes is in this side surface?

A. Yes.

Q. What is that purpose?

A. The only purpose of those holes is that if any obstruction, a leaf or weeds are floating around the main water intake, the motor won't over heat.

374 Q. In other words, they provide a sort of an auxiliary inlet in case the principal rectangular inlet which appears to be in accordance with that disclosed in the Arndt patent, these holes in the side surfaces are auxiliary inlets in case the large front openings should become blocked up; is that right?

A. That is correct.

Q. Would you say that in the ordinary operation of that motor water did flow in through those openings in the side walls?

A. I think that is a question you can only determine by actually testing it, and I have not done that.

Q. I am referring to your actual experience and what you know about this motor.

A. I can only tell you this, that those holes as they are placed there have no detrimental effect on the cooling system in normal operation.

Q. At that rate, you would say in normal operation there was no suction at the location of those holes?

A. No, I wouldn't say that, because you could have a small amount of suction there and it would not affect the cooling system.

Q. Suppose you got a leaf or something over the principal or main inlet, down near the barrel of the
375 propeller shaft housing and you had suction at that
point where these auxiliary holes are located, what would happen then?

A. It would still not change the picture. We have a centrifugal pump there and that will create a suction ahead rather than at the sides. The centrifugal pump will more than overcome the suction that you might encounter around the holes and then water is still going to circulate.

Q. That would be the case in defendant's devices as shown in Plaintiff's Exhibit 9, if the holes were cut in the side walls instead of being stepped back?

A. No difference between the defendant's device and the device you refer to in that regard.

Q. The section, that is, the housing section of this under-water part above the barrel of the propeller shaft, is substantially the same as the section shown in Plaintiff's Exhibit 8, which shows the defendant's 16-horsepower motor and is the second section from the bottom?

A. Yes.

Q. Mr. Irgens, in referring to this Johnson drawing, Plaintiff's Exhibit 19, which shows a design for an under-water unit of an outboard motor, is that unit
376 as shown in the drawing adaptable as a steering
element, and could a rudder be omitted entirely?

A. As that drawing is worked out, that motor was not intended to be turned.

Q. You say it was not intended to be turned and used for steering?

A. As that drawing is worked out, that is right.

Q. At the time that drawing was made, did the Johnsons plan to make another drawing of one that would be intended for steering?

A. Yes.

Q. I suppose you were acquainted with what was going on at that time by way of design of these under-water nits?

A. That is correct.

Q. What modification, if any, of the devices illustrated in this blue print, Plaintiff's Exhibit 19, would be made if you were going to use that under-water section for steering without a rudder?

A. The next motor that Johnson put on the market, that was turnable for steering, and that is substantially like the patent in suit.

Q. And it is substantially like the unit illustrated in this blueprint, Plaintiff's Exhibit 19?

377 A. It was, with certain modifications. When the job was put on the market it had a cylindrical drive shaft housing about which the motor turned. Outside of that, the motor was put out with stream lined walls below and above the anti-cavitation plate.

A. And that stream lined portion or the under-water unit was used for steering?

A. Yes.

Q. And it would be substantially like the one illustrated in this blueprint, Plaintiff's Exhibit 19?

A. With respect to the submerged surfaces, yes.

Q. Perhaps the lug or ear projecting at the back to take the rudder pintle would be eliminated or left off, wouldn't it?

A. Naturally so.

Q. You said the Johnsons had that in mind and you knew such a structure was to be built at the time this drawing was going to be made?

A. Johnson had been making motors that would turn for steering years before these were being designed, and motors were being designed right along in the engineering department.

Q. In the Johnson motors that were made before this drawing, Plaintiff's Exhibit 19, did they have a smooth

378 sided surface so that the under-water portion would act as a rudder for steering, or did they just depend entirely on the slip-stream?

A. Depended entirely on the slip-stream.

Q. You would say this stream lined design, then, was the first of the Johnson arrangements for using the under-water part for steering?

A. This particular device did not steer. This particular device is the first time I ever saw the combination of stream lined surfaces for internal water passages and a cavitation plate.

Q. That is the first time you ever saw it?

A. Yes.

Q. But you do know that at that time it was contemplated using substantially the same under-water unit in a device that would be turnable for steering and without a rudder?

A. Yes.

Mr. Rummler: That is all.

The Court: We will recess at this time until 2:00 o'clock.

Whereupon a recess was taken until 2:00 o'clock p. m. of the same day.

379 Wednesday, January 31, 1940.
2:00 o'clock p. m.

Court convened pursuant to recess.

Present:

Messrs. Wheeler, Wilkinson, Rummler.

FINN T. IRGENS resumed the stand.

Redirect Examination by Mr. Wheeler.

Q. Referring once more to the type of lower unit which is shown in the H. L. Johnson patent in suit No. 1,716,962, will you please state whether there is any cooperative relation between the stream lining as you have described it in that unit and the anti-cavitation plate as you have described it in that unit?

A. Yes, they cooperate to increase the efficiency of the housing and reduce a tendency to cavitate.

Q. Will you please state in what manner they cooperate to prevent cavitation?

A. Well, if you assume that if that stream line was left off, either above or below the anti-cavitation
380 plate, then the water lines and the drive shaft would be exposed and there would be much more of a tendency to cavitate and the plate would have to be made larger.

Q. Would that be true if the stream lining were omitted and the housing left without smooth walls either above or below the plate?

A. Yes.

Q. What is the fact as to whether you would get equal results, so far as cavitation is concerned, if the plate were omitted but the housing were left with smooth walls for its full height?

A. If the plate was omitted it would have a very much greater tendency to cavitate.

Q. Could you operate, say, a 16-horsepower motor or a 9-horsepower motor without an anti-cavitation plate under those circumstances?

A. Not with the dimensions as you are now using them.

Q. Referring to the defendant's own motors, Plaintiff's Exhibits 17 and 18, and the chart showing those which are here in evidence, for example, Plaintiff's Exhibits 5 and 8, is it a fact as to those motors that the stream lining or smooth walls of the housing above and below the anti-cavitation plate, with the water pass-
381 ages enclosed therein, are cooperative features to avoid cavitation?

A. Yes, they do cooperate.

Q. Now if you still retained the anti-cavitation plate and omitted the smooth walls, left the walls irregular, would you get cavitation in those particular motors?

A. Yes, I would expect to get cavitation.

Q. What effect does the use of the smooth walls above and below the plate have on the size of the anti-cavitation plate that it is necessary to use?

A. If the lines above and below the anti-cavitation plate are smooth, then the plate can be smaller.

Q. Is that desirable?

A. Yes; it reduces skin friction.

Mr. Wheeler: That is all.

Mr. Rummler: No recross examination.

Mr. Wheeler: I will call Mr. Beebe as the next witness.

382 JAMES H. BEEBE, called as a witness on behalf of plaintiff, having been first duly sworn, testified in rebuttal as follows:

Direct Examination by Mr. Wheeler.

Q. Please state your name, your age, your residence and your occupation.
A. My name is James H. Beebe; age, thirty-seven years; residence, Beloit, Wisconsin.
Q. Occupation?
A. I am in the engineering department of Fairbanks Morse & Company.
Q. Are you in any way connected with either of the parties to this suit?
A. No, sir.
Q. Have you ever been employed by Johnson Motor Company?
A. I was.
Q. For what period?
A. Three years.
Q. When?
A. From approximately October 1, 1926, to approximately October 1, 1929.
383 Q. What were your duties while employed by Johnson Motor Company?
A. I was a draftsman.
Q. What kind of drawings did you make there?
A. I made layout drawings, design drawings and details of some of them.
Q. Were Harry Johnson and Louis Johnson with the Johnson Motor Company at that time?
A. Yes, sir.
Q. Did you work with either Harry Johnson or Louis Johnson?
A. Both of them.
Q. I will hand you a drawing and ask you if you can identify it?
A. Yes, sir; that is a drawing I made at that time.
Q. When did you make that drawing?
A. Well, the drawing here is dated December 21, 1927.
Q. Who put that date on there?
A. I did; that is my signature and my writing.
Q. When did you put that date on the drawing?

A. I should say at the time the drawing was finished.

Q. When was it with reference to December 21, 1927?

A. The drawing was made before that time and at the time the drawing was finished, that is, the drawing
384 was finished approximately December 21, 1927.

Q. What I am getting at is, did you put that date on there on the date it purports to relate?

A. Yes, sir.

Q. Are there any other signatures or memoranda written on this drawing?

A. Well, there is a note by Mr. Harry Johnson, with his initials.

Q. In whose handwriting is that note?

A. In his handwriting.

Q. Did you say that you personally put your own name on the drawing?

A. Yes, sir.

Q. To what does this drawing relate?

A. That is the lower part of a gear case. It relates to the actual gear housing and propeller and the anti-cavitation plate and the water scoop bearings in the lower part of the drive shaft.

Q. Does this drawing have anything on it to show the cross-sections of the housing above and below the anti-cavitation plate?

A. Yes, sir; there are two views,—four views here which give an idea of the cross-section.

Q. Will you please state which view shows the
385 cross-section of the housing below the anti-cavitation plate?

A. This view (indicating). I will have to mark it some way.

Q. Will you mark it section AA and then draw the section on the principal view to show where it is taken?

A. This shows only the outside. It does not purport to show the internal construction.

Q. Please speak louder. I don't think they can all hear you.

A. This does not show the internal construction. It shows the line on the outside at this point.

Q. The contour?

A. The contour of the outside of the housing.

Q. Now will you please state whether there is any view on this sheet that shows the cross-sectional contour above the anti-cavitation plate?

A. This view BB.
Q. Will you please mark the view BB?
A. (Witness does as requested.)
Q. And mark the place at which that section is taken.
A. (Witness does as requested.)
Q. Now what is the contour of that housing above the anti-cavitation plate?
A. It is substantially stream lined with a sharp
386 forward edge, that is, a sharp forward edge as compared to the blunt forward edge.
Q. What is the nature of the trailing edge?
A. Also sharp, similar to the front edge.
Q. What is the nature of the contour at AA below the anti-cavitation plate?
A. It has a blunt forward edge and a sharp trailing edge.
Q. At whose direction was this drawing made?
A. Mr. Louis Johnson's.
Q. Did he tell you what to show in those regards?
A. I should say he did. It has been twelve years, of course, but I should say he did.

Mr. Wheeler: You may take the witness for cross-examination.

Mr. Rummler: No cross-examination.

Are you going to introduce that drawing in evidence?

Mr. Wheeler: I will offer the drawing in evidence as PLAINTIFF'S EXHIBIT 20, and will ask that it be so marked.

(The exhibit was so marked.)

Mr. Rummler: Does he show what patent this drawing relates to, Mr. Wheeler?

387 Mr. Wheeler: No, the drawing does not, but it relates to the second patent No. 1,763,970, Plaintiff's Exhibit 11.

I will call Mr. Louis Johnson.

LOUIS J. JOHNSON, called as a witness on behalf of the plaintiffs, having been first duly sworn, testified in rebuttal as follows:

Direct Examination by Mr. Wheeler.

Q. Please state your name, age, residence and occupation.

A. My name is Louis J. Johnson; age fifty-eight; occupation, engineer, and residence, Miami, Florida.

Q. Are you the same Louis J. Johnson who was one of the joint applicants for United States Patent No. 1,559,616?

A. Yes.

Q. Have you been connected in any way with Johnson Brothers Engineering Corporation, the plaintiff in this case?

A. Yes.

Q. In what capacity?

388 A. As president.

Q. For how long?

A. Since the company was organized, I think it was about '21.

Q. Have you been since 1921 connected in any way with Johnson Motor Company?

A. I was chief engineer for the Johnson Motor Company from, I think it was 1921, from the time it was organized until about 1931.

Q. Did you have anything to do with the drafting and development work by the plaintiff of that company?

A. Yes.

Q. I will hand you Plaintiff's Exhibit 19, and ask if you can identify it?

A. Yes.

Q. Please state what it is.

A. This is the structure of the stream line and anti-cavitation plate invented by my brother, Harry Johnson.

Q. Do you know when that drawing was made?

A. It was drawn prior to May 23, 1924.

Q. How do you know that?

A. By the signature of Harry Johnson here with that date, showing the time it was drawn.

Q. Can you identify that signature?

389 A. Yes.

Q. Have you previously seen that drawing?
A. Yes, I have.
Q. When?
A. I saw it prior to May the 23rd, 1924.
Q. Did you see it before it was completed in its present form?
A. Yes.
Q. Was that the sole invention of Harry Johnson?
A. It was.
Q. Was it disclosed to you by him, or someone else?
A. By him.
Q. When?
A. Prior to May 23, 1924.
Q. Are you familiar with the signature of Mr. Finn Irgens?
A. Yes.
Q. Is there anything on that drawing representing that signature?
A. Mr. Irgens checked the tracing June 17, 1924.
Q. How do you know that?
A. By seeing his signature there over that date.
Q. Can you identify it as his signature?
A. Yes.
390 Q. In what capacity was Mr. Irgens working at the time?
A. He was my assistant.
Q. Doing what?
A. Engineering.
Q. In what capacity was Mr. Harry Johnson working at the time?
A. He was an engineer under my supervision.
Q. Did Mr. Irgens and Mr. Harry Johnson have offices near each other?
A. They were in the same office, a small office.
Q. What was that office used for at that period?
A. For drafting, engineering.
Q. I will hand you Plaintiff's Exhibit 20, and ask you if you can identify it.
A. Yes, that is a drawing of the subject matter of one of my patents.
Q. When was that drawing made?
A. It was made prior to December 21, 1927.
Q. Can you identify the patent to which you have referred?
A. I do not recall the number.

Q. Is this the one?

A. Yes, that is it.

391 Q. No. 1,763,970?

A. Well, I don't remember the number, but I presume that is it.

Q. What is the subject matter shown in that drawing, Plaintiff's Exhibit 20?

A. The general subject matter is that of a combination of stream line and anti-cavitation plate having both forward and rear edges wedge-shaped above the anti-cavitation plate and a blunt forward edge below the plate and a sharp rearward edge.

Q. At whose instructions was this drawing, Plaintiff's Exhibit 20, made?

A. Mine.

Q. Yours, did you say?

A. Yes.

Q. Did you give those instructions personally to Mr. Beebe?

A. Yes.

Q. Can you identify this signature which appears alongside of the lower unit in this drawing?

A. That is the signature of Harry Johnson.

Q. Have you seen that before, do you recall having seen that before?

A. Yes.

392 Q. When?

A. You mean this (indicating).

Q. I mean the signature.

A. Oh, yes. It has been used on various drawings from time to time.

Q. I mean, can you recall that signature appearing on this particular drawing?

A. Yes.

Q. When did you first see it before?

A. I don't remember.

Mr. Wheeler: That is all.

Cross-examine, Mr. Rummler.

Cross-Examination by Mr. Rummler.

Q. Mr. Johnson, was it in 1927 when you devised the design for this stream lined construction shown in your patent No. 1,763,970?

A. Well, I can't remember the date.

Q. I mean the year, approximately, this drawing that you have just referred to, Plaintiff's Exhibit 20.

A. It would be prior to December 21, 1927.

Q. Yes, but it would be in 1927, would it not?

A. I don't know.

393 Q. Do you have any recollection of about how long before this drawing was made it was that you devised this design?

A. No, I do not.

Q. Mr. Johnson, how did you come to devise this particular design for an under-water drive shaft and gear casing on an outboard motor?

A. Well, I had in mind that it might be more efficient with a blunt under-structure low down with a blunt section on the portion below the anti-cavitation plate and using the wedge-shape above the plate.

Q. At the time you devised this design, Mr. Johnson, were you familiar with the principles of stream lining, generally speaking, the art of stream lining?

A. I thought so.

Q. From your experience with water vehicles and water propulsion devices, why would you say there is an advantage to having a sharp leading edge at the water line?

A. Because it cut the water with less waves.

Q. Less bow wave, do you mean?

A. Yes.

Q. That is, it would push less water ahead of the section that was passing through it at the water line?

394 A. Yes.

Q. Were you familiar with a pear-shaped stream lined section for under-water struts at that time?

A. I had never seen a strut of that shape.

Q. A pear-shaped section?

A. No, I do not get your idea.

Q. That is, with a blunt leading and a knife-edge trailing edge?

A. No, I don't believe I had seen one on a boat.

Q. Had you ever heard of that section as being advantageous in stream lining of under-water parts?

A. Yes.

Q. Then in devising this section, you chose the most appropriate stream lined contours that would fit the portions of the device that were at the water line and below the water line, did you not?

A. I thought so; yes.

Q. Was it not your principal aim to make your surface contours as fair and uninterrupted as possible in the entire under-water unit?

A. It was.

Q. Mr. Johnson, what was it, then, that you invented when you devised this under-water casing shown in your patent No. 1,763,970?

395 Mr. Wilkinson: I object to the question. The Claims speak for themselves. They define what it was that the inventor invented.

Mr. Rummler: The claims attempt to define something, but the whole issue here is what? And we question what was invented there. Stream lining as such is old and well-known practice.

The Court: If the direct warrants it, I will be glad to let him answer the question. I do not want to open the case up any wider than necessary. What was in the direct that warrants it?

Mr. Rummler: Mr. Johnson has testified that this is his invention and he has said that the drawings were made under his instructions, which was, we presume, the first drawing for this particular device as shown.

The Court: He is not testifying as a patent expert at all?

Mr. Rummler: No, he is not.

The Court: He identified his drawing. What else has he done that you are asking about?

Mr. Rummler: He has said he is the inventor and it should be presumed that the inventor should know what he invented.

The Court: Well, sometimes an inventor does, and
396 maybe sometimes an inventor is like some of the rest of us.

Mr. Rummler: And leaves it to his patent attorney.

The Court: When we come to make statements about our own legal rights, sometimes we do not state them very accurately.

What is the best testimony in your favor that warrants that question?

Mr. Rummler: The fact that Mr. Johnson has stated that he is the inventor of this design for an underwater device.

The Court: He has not attempted to explain the claims?

Mr. Rummler: No, he has not attempted to explain the claims.

The Court: Or to explain the device, or anything about it? He just simply identified the drawings and said, in effect, "Here are the drawings made under my direction. I am the Mr. Johnson who made that invention." Isn't that what he said?

Mr. Rummler: Yes, that is right, your Honor.

The Court: Objection sustained.

Mr. Rummler: That is all.

Mr. Wheeler: I will call Mr. Tanner.

397 Your Honor, Mr. Tanner wanted me to make known to you the fact that he is quite hard of hearing.

The Court: Very well.

PHILIP ARTHUR TANNER, called as a witness on behalf of the plaintiffs, having been first duly sworn, testified in rebuttal as follows:

Direct Examination by Mr. Wheeler.

Q. Please state your full name, your age, your residence and your occupation.

A. My name is Philip Arthur Tanner; age, fifty; residence, Waukegan, Illinois; occupation, vice-president of Outboard, Marine & Manufacturing Company, in charge of Johnson Motors Division, sales.

Q. For how long have you been connected with the outboard motor business?

A. I first became connected with it in October, 1921.

Q. With what company?

A. Johnson Motor Company.

Q. For how long did you remain with the Johnson Motor Company at that time?

A. Until April 30, 1924.

398 Q. Were you subsequently connected with the Johnson Motor Company?

A. Yes, I came back to Johnson in November, 1931, and I have been with them since.

Q. Are you familiar with the type of lower unit construction which is shown on this chart reproduced from the drawings of the Johnson patent No. 1,716,962?

A. I am.

Q. Do you recall when such a construction was introduced to the market, and by whom?

A. To the best of my recollection it was for the model

year of 1926; which would mean it was probably introduced about January or February of 1926.

Q. By whom?

A. By Johnson Motor Company.

Q. At that time was Evinrude Motor Company a competitor of Johnson Motor Company?

A. Yes, they were.

Q. At that time was Elto Motor Company a competitor of Johnson Motor Company?

A. Yes.

Q. At that time was Lockwood-Ash Motor Company a competitor of Johnson Motor Company?

A. Yes.

399 Q. What was the result of the introduction of this model by Johnson Motor Company in 1926?

A. As far as I was concerned, I was connected with the Lockwood-Ash Motor Company that was making a motor in 1926 and not having that combination; and, not having it, we did not have the satisfactory performance that the Johnson combination had.

Q. In what respect did your motor not have as satisfactory a performance?

A. It had cavitation.

Q. What did your motor lack particularly of the structure shown in this Johnson patent?

A. We did not have an anti-cavitation plate.

Q. What did you do to remedy this difficulty?

A. In the fall of 1926, for the 1927 model year, we put on an anti-cavitation plate.

Q. Did that remedy your difficulty, so far as cavitation was concerned?

A. Yes.

Q. Do you know what was done by Evinrude and Elto?

A. My recollection is that possibly, not at the same moment, I doubt Evinrude did the same year, put on an anti-cavitation plate on the stream line housing. I don't remember clearly whether Elto did it that year or

400 the next, but they subsequently did put on the same combination.

Q. Has that construction of lower unit gone into general use on large-sized and high-powered outboard motors?

A. I cannot think of any made today that does not have that combination.

Q. Do you believe that the 9-horse power or the 16-horse power outboard motor could be operated successfully

without having smooth walls above and below an anti-cavitation plate and having the water passages inside?

A. I don't believe it could.

Q. Is there any cooperation between the smooth walls of the housing and the anti-cavitation plate in the operation of such a motor?

A. Yes.

Q. In what respect?

A. If you have smooth walls but no anti-cavitation plate, you can get cavitation. If you do not have the smooth walls and you do have an anti-cavitation plate, the plate must be very large in order to prevent cavitation. If you have the combination of smooth walls and an anti-cavitation plate, you can have a smaller plate and bet-
401 ter over-all efficiency.

Q. From what does that over-all efficiency result in the completed lower unit?

A. I didn't quite get that.

Q. From what features of the completed lower unit does that over-all efficiency result?

A. The combination of less resistance to passage through the water and best possibility to prevent cavitation occurring.

Q. What is the nature of the cavitation which the plate seeks to prevent?

A. It is the creation of a sort of vacuum around or inside of the propeller blades, which, which sucks air down along the gear case and into the propeller slip-stream.

Q. How does the plate prevent such cavitation?

A. It prevents that downwardly directly stream of water and air getting to the propeller and directs it backward where the propeller cannot operate on it.

Q. For the successful operation of an anti-cavitation plate, should there be an uninterrupted stream of water over the plate?

A. Yes.

Q. What effect does the anti-cavitation plate have
402 as to the shortness of the path which air would be
obliged to follow if it did reach the propeller?

A. I didn't quite get that question.

Q. What effect, if any, does the plate have as to the shortness of the path which the air would have to follow if it did get to the propeller?

A. The anti-cavitation plate would require the air to follow a considerably longer path to get to the propeller.

A. Are you in the practive of operating an outboard motor yourself?

A. Occasionally.

Q. Do you operate outboard motors having a smooth walled lower unit with an anti-cavitation plate intermediate its top and bottom?

A. That is the type I do operate now if I operate one, yes.

Q. In the operation of such a motor, would you consider it safe to wait until you were within twenty feet of the pier, in full speed operation, before cutting off your power?

A. With what sized power motor?

Q. With either a 9-horse power or a 16-horse power outboard motor?

403 A. I should think I would want to cut off the power considerably further away, depending on the type of boat, of course, possibly, fifty, seventy-five, maybe a hundred feet away.

Q. Have you made a practice of cutting off the power when some distance away from the pier or slip at which you are trying to land?

A. Yes.

Q. When you do that, how do you maneuver your boat in approaching the pier or slip?

A. By steering with the turning of the motor.

Q. In turning the motor, do you use the tiller handle 9?

A. Do I use what?

Q. The tiller handle shown at 9 in the drawing of the patent?

A. Yes; turn the motor with the handle.

Q. How does that accomplish steering?

A. The flat surfaces of the gear case below water act as a rudder.

Q. Can you steer a boat using the gear case as a rudder when the propeller is not in operation?

A. Yes.

Q. Do you do that yourself?

A. Yes.

404 Mr. Wheeler: That is all.

If your Honor please, while this witness is on the stand, I should like to offer as PLAINTIFF'S EXHIBIT 21, a tabulated list of the sales of the Johnson Division and the Evinrude Division from 1926 to date, which shows the total number of motors sold, the total number of motors

having this stream lined feature, and the list value of the motors, and the percentage of the total that have the stream lined features.

Mr. Rummler is willing to stipulate that the witnesses from the Johnson Division and the Evinrude Division, if called, would substantiate these figures, but Mr. Rummler would like to examine Mr. Tanner concerning them.

The Court: Very well. It may be admitted.

(The exhibit was so marked.)

Cross-Examination by Mr. Rummler.

Q. Mr. Tanner, you testified as to a number of dates as to when you entered this outboard motor business and when various events happened. How do you establish those dates?

A. Well, when you are out of a job and you get one,
405 you usually remember it.

Q. Do you rely entirely on your recollection for those dates?

A. No, I have various records that I refer to when I want to be sure of them.

Q. Did you refer to those records before you came here to testify?

A. Yes.

Q. Mr. Tanner, what is the extent of your engineering experience with regard to outboard motors?

A. I have not been employed in the engineering department designing outboard motors, but I have been in the position for a number of years of cooperating very closely with the designers and, in fact, assisting them some on tests, physical tests of motors which they have designed. I have an engineering training and take a great deal of interest in that end of it and have done quite a lot of it.

Q. Mr. Tanner, you have testified that a propulsion device of the nature of the one shown in Johnson patent No. 1,716,962 as to the steering that can be had when the motor is shut off. Now when you shut the motor off, let us say thirty feet or forty feet from the dock, how
406 much can you turn the boat after the motor has stopped rotating?

A. I would have to qualify my answer considerably as to the size of the motor, the speed at which I was driving the boat, the type of boat and wind, and those various factors.

Q. Let us say you were driving a boat that had sufficient power to travel at fifteen miles an hour and you were heading straight for the dock and shut your motor off forty feet from the dock. How much would you be able to turn that boat in its direction?

A. I imagine I would hit the dock about forty-five degrees on the bean if I was going fifteen miles an hour and did not shut off the power until I got within forty feet.

Q. Would you have enough steering effect then to turn the bow of the boat through forty-five degrees so as to bring the boat parallel with the dock if you were coming up to the side of it?

A. I would judge so.

Q. From your experience in the operation of outboard motors, have you ever had that much steering under such conditions?

A. I do not recall any specific instance, but that would be my best judgment.

407 Q. Would you be able to turn the boat through an angle of ninety degrees with the motor shut off and just relying on the side surfaces of the under-water portion as a rudder?

A. I think by employing proper judgment as to when to shut it off and changing my speed, and all that, and no wind involved, I believe I could come in sidewise to the dock, having shut off the power when going directly toward the dock.

Q. How does the wind affect steering with such a device?

A. Well, the wind affects the steering of any boat by blowing one side or the other on the free port and making a course that tends to turn the boat off of its course. You have to compensate for that by your steering mechanism in the opposite direction.

Q. Mr. Tanner, what effect, if any, does the propeller have, when it has stopped rotating, on the steering?

A. I don't believe it has any.

Q. Even if the propeller were off balance?

A. I don't understand what you mean by off balance.

Q. I will explain that, Mr. Tanner. Ordinarily, these propellers, I believe, are three-bladed propellers, and
408 a balanced propeller would be with one blade vertical and the other two blades at a hundred and twenty degrees of the vertical.

A. I see.

Q. Now an unbalanced propeller would be with the blades in another position, unless the blade was again vertical—

A. You mean with a three-bladed propeller two blades might stick out on one side and the other on the other when it would come to stopping position?

Q. Yes?

A. I don't believe that would affect the steering.

Q. In your experience with the operation of outboard motors, have you ever observed any effect at all from the propeller?

A. I have not.

Q. How fast does a boat decelerate or decrease its speed after the motor has been shut off, let us say, when you are traveling at fifteen miles an hour?

A. I would have to know what kind of a boat it was.

Q. It would vary though, with the type of boat, wouldn't it?

A. Very much.

Q. Suppose it was a displacement boat with a
409 round bottom?

A. I don't know what terms to express deceleration in. In that particular case, I would say if I would shut off the power going fifteen miles an hour and I was between seventy-five and a hundred feet from an obstruction, a dock, perhaps, that I would probably decelerate pretty close to zero by the time I got to the dock.

Q. Would your deceleration at first be rather sudden?

A. Rather. That is right, at the first instant.

Q. That is what I mean, Mr. Tanner. With reference to Plaintiff's Exhibit 21 that was just introduced by Mr. Wheeler, could you tell what the extent of advertising was that was done to promote the sales that are shown by this Plaintiff's Exhibit 21?

A. I have not referred to the records and I cannot tell you a complete story about it. I think it was 1929 the Johnson Motor Company spent in the neighborhood of $560,000 for all forms of advertising.

Q. Since that period, Mr. Tanner, has the advertising budget been decreased?

A. Very materially.

Q. For the last three years, what would you say was the percentage of the 1929 volume that was expended?

410 A. You mean 1937, 1938 and 1939?

Q. Yes, that will be all right.

A. In 1937 I would say it was about ten per cent. In 1938, possible twelve per cent. In 1939, close to twenty per cent.

Q. Mr. Tanner, was that sum spent by the Johnson Motor Company or by the Outboard, Marine & Manufacturing Company?

A. I am speaking of the Johnson Division alone.

Q. You are speaking of the Johnson Division alone?

A. Right.

Q. How would the advertising expenditure of the Johnson Division alone compare with that of the Evinrude Division?

A. I don't know definitely, but I think they are just about the same.

Mr. Rummler: That is all, Mr. Wheeler.

Thank you, Mr. Tanner.

411 *Redirect Examination by Mr. Wheeler.*

Q. You think they were about the same in 1929 also, or were they different at that time?

A. I beg pardon?

Q. Were the advertising expenditures of the two companies about the same in 1929 also, or were they different?

A. Speaking from not very definite information, but a general idea of the subject, I would say that Evinrude in 1929 spent probably not fifty per cent of what Johnson did in that year.

Q. Was the Johnson advertising directed to any one feature, or was it general advertising of outboard motors?

A. It was general advertising of motors.

Q. In your opinion, is it possible for a propeller which is balanced in operation to be unbalanced when it is at rest?

A. I would't think so; no.

The Court: Your idea of that would be the center of the area on opposite sides of the center ought to be the same; is that the idea?

412 A. The area is evenly divided throughout the full circumference.

The Court: The center of area, not the center of gravity but the center of area, what would you call that?

Mr. Wheeler: Center of moment, I would call it.

The Court: What would he call it?

Mr. Wheeler: Q. What would you call the force acting at any time to displace an object around a pivot?

A. A moment.

Q. And that moment is made up of the force and its distance radially from the pivot, is it not?

A. That is right.

The Court: Well, I have it.

Mr. Wheeler: Q. And if you take a three-bladed propeller and have two blades on one side of the pivotal axis and one blade on the other, will the greater radius of the blade which is on the one side give it a moment equal to the shorter radius of the two blades on the other side?

A. I think it will. I think it will still be in balance.

Mr. Wheeler: That is all.

Mr. Rummler: That is all.

413 HARRY L. JOHNSON, called as a witness on behalf of the plaintiffs, having been first duly sworn, testified in rebuttal as follows:

Direct Examination by Mr. Wheeler.

Q. Please state your name, age, residence, and occupation.

A. Harry L. Johnson; age, fifty-five; Culver, Indiana; mechanical engineer.

Q. With whom are you connected as mechanical engineer?

A. Johnson Brothers Engineering Corporation.

Q. Have you worked at the plant of Johnson Motor Company?

A. I have.

Q. In what capacity?

A. Mechanical engineer.

Q. Have you done drafting there?

A. Some.

Q. Are you the same Harry L. Johnson named as a joint inventor in United States Patent No. 1,574,977?

A. I am.

Q. Are you the same Harry L. Johnson named as

414 sole inventor in U. S. Patent in suit No. 1,716,962?

A. I am.

Q. At what period have you done drafting work in the plant of the Johnson Motor Company?

A. From 1922 until 1935.

Q. I will hand you Plaintiff's Exhibit No. 19, and ask if you can identify it?

A. This is my drawing. It is a blue print from a tracing of my drawing.

Q. Did you personally make that drawing?

A. I did.

Q. Did you place your name on any part of it, and if so, where?

A. I placed my name on this tracing of this blue print.

Q. In what way and how?

A. As drawn by me. It is my signature, it was drawn May 23, 1924, and traced June 12, 1924, and checked June 12, 1924.

Q. Did you personally make each of those notations on that tracing?

A. I did.

Q. At what date did you place those notations on the tracing?

415 A. The same date as is under the signature.

Q. Are you familiar with the signature of Mr. F. T. Irgens?

A. I am.

Q. Can you identify anything on that drawing as being written by him?

A. His signature.

Q. In what way does it appear on the drawing?

A. F. I.—F. T. I can't make out this thing. It is F. I. and it is June 17, 1924.

Q. Is that also in his handwriting?

A. That is his handwriting.

Q. When did you make this drawing of which this is a tracing?

A. Prior to May 23rd in the year 1924.

Q. Whose idea is represented in that drawing?

A. It is my idea.

Q. Is it your sole idea?

A. It is my sole idea.

Q. What was the relationship in the Johnson Motor Company between your desk or place at which you worked and the place at which Mr. Irgens worked?

A. They were close together, a short distance apart in the same small office we had at that time.

416 Q. They were both in the same office?

A. Yes.

Q. I will hand you Plaintiff's Exhibit 20, and ask you if you are familiar wth the disclosure of that?

A. I am.

Q. Is there any memorandum on this print with which you are familiar?

A. There is a memorandum at this point signed by me, H. L. J., and it says, "Make this section same as 9-horse power case," the distance upwardly from the anti-cavitation plate.

Q. To what point?

A. To the top of the gear case.

Q. Who placed that memorandum on that drawing?

A. I did.

Q. When did you place that memorandum on that drawing?

A. Well, it was on or about this time when Mr. Beebe's signature and date were put on the drawing, probably a little previous to that time.

Q. Do you remember independently when you put it there?

A. No, I do not.

Q. Do you know what that drawing shows with reference to its structure?

417 A. It shows a stream lined gear case with an anti-cavitation plate, with a sharp wedge-shaped section above the plate and a blunt nose section below the plate, down as far as the gear case proper, the barrel-shaped part.

Q. Whose idea was that?

A. It was Mr. L. J. Johnson's idea in the stream lining.

Q. Do you know who made the drawing?

A. Mr. Beebe.

Q. At whose direction?

A. Under my supervision.

Q. Can you identify his signature?

A. Well, that is his signature here. I really could not identify it. I have not seen his signature since that time; that is some time ago now.

Mr. Wheeler: That is all.

Mr. Rummler: No cross-examination.

Mr. Wheeler: That is all, Mr. Johnson.

I would like to examine Mr. Spurgeon adversely for a moment.

418 WILEY W. SPURGEON, called as a witness on behalf of the plaintiffs, having been first duly sworn, testified in rebuttal as follows:

Direct Examination by Mr. Wheeler.

Q. Please state your name, residence and occupation.

A. My name is Wiley W. Spurgeon; I live at Muncie, Indiana; I am secretary and treasurer of the Muncie Gear Works, of Muncie, Indiana.

Q. How long have you been connected with the Muncie Gear Works?

A. I have been connected with the Muncie Gear Works, Inc., since 1934, which is the date of its incorporation.

Q. Now then, you have been connected with the managment of that company during that period?

A. Yes.

Q. Has the Muncie Gear Works been making outboard motors since the date of its incorporation?

A. Yes.

Q. For what part of that period have you known of the patents involved in this litigation?

A. I have had personal knowledge of those patents,
419 that is, official knowledge, beginning in 1935, I believe about January.

Q. You were notified of infringement at that time?

A. I believe that is about the date.

Q. Were you connected with a prior concern also known at Muncie Gear Works, or some similar name?

A. Yes.

Q. That concern was sued, was it not, under Evinrude patent No. 1,786,835 here in suit?

A. I believe that is correct.

Q. It was also sued, was it not, under Irgens patent No. 1,869,749, on the tapered exhaust pipe?

A. I don't remember that particular patent, Mr. Wheeler, that is, as being involved at that time.

Q. How long after the present Muncie Gear Works was incorporated was it before you were producing outboard motors for the market?

A. Immediately.

Q. Did you make use of the outboard motors which you derived from the predecessor concern?

A. Please explain that question a little more clearly.

Q. Did you acquire from the predecessor concern a stock of outboard motors?

A. A small stock; yes.

420 Q. Did you proceed to sell those?

A. Yes.

Q. Were you also sued, or was the original Muncie concern also sued, by the Johnson Motor Company under Johnson patent No. 1,716,962?

A. I believe that is true.

Q. Was it also sued by Johnson Motor Company under Johnson patent No. 1,763,970?

A. I also believe that is true. I do not remember those patent numbers.

Q. What became of the original Muncie Company that was sued?

A. I believe that it was dissolved by court order. I could not answer that definitely; I do not know.

Q. And the assets were bought by you and your brothers?

A. May I qualify that statement by saying finally, yes. You speak of physical assets, Mr. Wheeler?

Q. Yes. How much does the present Muncie Gear Works spend annually in advertising?

A. I am not in position to give those figures because I do not know.

Q. I believe you have stated within the last few days, during the progress of this trial, that you spend less than $10,000 annually in advertising?

421 A. I do not remember having made that statement.

Q. Is it not a fact?

A. I could not answer that question truthfully, Mr. Wheeler, because I do not know.

Q. Not even in general terms?

A. I would say that our advertising bill would be more than that.

Q. On outboard motors only?

A. No, I would say it would be divided up on other products, along that though, but I can't give you those figures; I do not know.

Q. How much of an engineering department do you maintain?

A. We employ about eight men, I believe in our engineering department. I do not vouch for that definitely, but I believe that is about the number.

Q. In what capacity?

A. Chief engineer and an assistant and various draftsmen and blue print boys.

Q. The figure of eight that you give includes the draftsmen and blue print boys?

A. I believe that is correct; yes, sir.

Q. Your outboard motors, that is to say, defendant's outboard motors, are consistently sold at prices lower
422 than those of the plaintiff for corresponding models, are they not?

A. I believe that is correct; yes.

Q. I will show you a catalogue purporting to be the catalogue of the Evinrude Motor Company for 1929, and ask you if you were familiar, in 1929, with the Evinrude motor shown on page 15 of that catalogue?

A. No.

Q. Were you familiar with the catalogue?

A. No.

Q. I will show you an Evinrude catalogue purporting to be the Evinrude catalogue for 1930, and ask you if you were familiar in 1930 with the outboard motors shown on pages 18 and 19 of that catalogue?

A. To the best of my knowledge, I don't believe I saw an Evinrude catalogue, Mr. Wheeler, until sometime in the latter part of 1930. I paid no particular attention to that at that time, I might have seen it, I don't remember it particularly, of paying attention to it.

Q. Does your answer refer both to the catalogue and the motors shown in the catalogue?

A. My answer refers to the catalogue. I believe I saw a 14-horse power motor in the summer of 1930
423 and bought one.

Q. I show you Evinrude catalogue for 1930, and ask you if you are familiar with the Evinrude motors shown on pages 16 and 17 of that catalogue?

A. Mr. Wheeler, I am no more familiar with these motors than having casually seen them at the boat shows and possibly read the specification of them.

Q. Do you remember seeing the catalogue in 1931?

A. I do not specifically remember seeing it, although I probably did.

Q. You attended the Motor Boat Show in that year?

A. I believe I did; yes. I would not want to make a definite statement because I missed two years and I don't know what years it was.

Q. Your Muncie Gear Works as organized at that time

was producing outboard motors in 1929, 1930 and 1931, was it not?

A. No, sir; we produced our first outboard motors in 1930.

Q. 1930?

A. That is right, sir. We might have built one or two experimental models in the fall of 1929, but not to exceed one or two motors.

Q. At the time you built them, did you have
424 Johnson and Evinrude motors at your plant?

A. Yes, of the small sizes only.

Q. You did not have at that time any models with the tapered exhaust pipe?

A. Not to my knowledge, Mr. Wheeler. I do not remember what kind of exhaust they had on those small motors. I believe they were above water exhausts, atmospheric exhausts.

Mr. Wheeler: I will offer in evidence as PLAINTIFF'S EXHIBIT 22 the 1929 Evinrude catalogue.

(The exhibit was so marked.)

As PLAINTIFF'S EXHIBIT 23, the 1930 Evinrude catalogue.

(The exhibit was so marked.)

As PLAINTIFF'S EXHIBIT 24, the 1931 Evinrude catalogue.

(The exhibit was so marked.)

Mr. Wheeler: That is all.

425 *Cross-Examination by Mr. Rummler.*

Q. Mr. Spurgeon, what became of the suits against the Muncie Gear Works to which Mr. Wheeler referred?

A. I believe those suits which were filed against the receiver of the Muncie Gear Works were withdrawn.

Q. Do you mean they were dismissed before trial?

A. That is correct.

Q. On whose motion were they dismissed?

A. I couldn't answer that question, although I believe it was on the motion of the plaintiff.

Q. To the best of your recollection, Mr. Spurgeon, when did the present Muncie Geor Works, Incorporated, first adopt the tapered exhaust tube?

A. We inherited that design from the old company, if that answers your question.

Q. Then the tapered exhaust pipe that you are using

at present on the 16-horse power motor, is that the same as was used by the old company?

A. Yes.

Q. Do you know why the tapered exhaust tube was adopted and used?

A. Yes, we liked the appearance of it. It was
426 adopted for eye appeal.

Q. Do you know whether or not any particular care was given as to the ratio of the end area dimensions of the tapered portion of the exhaust tube?

A. I would say that no particular care was given.

Q. Do you use a straight exhaust tube on some of your motors, Mr. Spurgeon?

A. Yes.

Q. As far as the cost of manufacturing exhaust tubes is concerned, with an exhaust chamber or head between the cylinder heads, that is, the exhaust expansion chamber of the same size as is used on the 16-horse power motor, would it be more expensive to use a straight tube construction than a tapered tube construction?

A. It is according to how the casting is manufactured, Mr. Rummler. If it was manufactured by our present method, which we do because our lower stem only steers, I would say it would cost approximately the same. There might be a slight saving in metal. We would prefer to cast that tube as one solid casting, and in bringing it up straight there might be a slight saving of metal only of, I am guessing, say half a pound of metal.

427 Q. If you were to have the straight exhaust tube bolted on to the expansion chamber at the top, that is, this cylindrical portion, would the cost be more than for the cast tapered tube as you now use it?

A. If I was going to design or go about designing a tube that would meet my requirements, I would have to have one that would be fixed very rigidly to the upper drum or the T, and that would mean that I would have to bolt it on, which would mean a machine operation on the opening of the drum or T and a corresponding machine operation on the casting which we would probably use, so it would fit the drum and hold it on. I would consider that a more expensive method of manufacture than our present individual casting.

Mr. Rummler: That is all.

Redirect Examination by Mr. Wheeler.

Q. In view of your last answer, why did you, in your 9-horse power motor, use a straight exhaust pipe?

A. Because we explode only one cylinder at a time so that the volume of exhaust is just one-half what it would be if that was all an opposed motor.

Q. As far as the machining and all those ele-
428 ments, rigidity and so on, which you just mentioned, you have the same problem, however, in the Plaintiff's Exhibit 5 construction as you did in the Plaintiff's Exhibit 8 construction, don't you?

A. This would require a different type of construction. Our manifold is bolted on the side of that engine at a flat place and is an awkward thing to cast.

Q. But you do have the same problems as far as rigidity is concerned and machining?

A. The machining price is very low. We merely core and drill the outlet over the cylinder or manifold and that tube slides in.

Q. You were connected with the management of the old Muncie Gear Works, were you not?

A. I was connected in a slight way. I was not an officer of the company. I worked there.

Q. Those original suits against Muncie Gear Works were settled pursuant to a stipulation with the receiver to the effect that a settlement had been made and that the concern was going out of business; isn't that the fact?

A. I couldn't answer that question. I am not familiar with that, Mr. Wheeler.

Mr. Wheeler: All right.
429 I should like to offer these charts in evidence.

I will offer the enlarged chart of Plaintiff's Exhibit 5 as PLAINTIFF'S EXHIBIT 5-A.

(The exhibit was so marked.)

I will offer the large chart of Plaintiff's Exhibit 8 as PLAINTIFF'S EXHIBIT 8-A.

(The exhibit was so marked.)

I will offer the large chart of Plaintiff's Exhibit 9 as PLAINTIFF'S EXHIBIT 9-A.

(The exhibit was so marked.)

I will offer the reproduction of the drawings of Johnson patent No. 1,716,962 as PLAINTIFF'S EXHIBIT 25.

(The exhibit was so marked.)

I will offer the enlarged chart of the drawings of the patent in suit No. 1,763,970 as PLAINTIFF'S EXHIBIT 26.

(The exhibit was so marked.)

I will offer the enlarged chart of Evinrude patent No. 1,786,835 as PLAINTIFF'S EXHIBIT 27.

(The exhibit was so marked.)

I will offer the enlarged chart of the drawings of the Arndt patent in suit No. 1,875,912 as PLAINTIFF'S EXHIBIT 28.

430 (The exhibit was so marked.)

I will offer in evidence as PLAINTIFF'S EXHIBIT 29 the Speedy Twin outboard motor of plaintiff's manufacture, which has been referred to in the course of the trial.

(The exhibit was so marked.)

Referring now to the spark plug cover patent, Johnson patent No. 2,067,533, I wish to state that the parties would like to have in the record some documentary showing as to the nature of that and all we have at present is an imperfect drawing, which perhaps does not do full justice from the defendant's point of view in the matter because it does not show the cylinder head in a form which provides as much clearance around the spark plug as there actually is in the motor, and with your Honor's permission and defendant's permission we will offer such print as we have in evidence as PLAINTIFF'S EXHIBIT 30, with the understand that we will substitute either the revised drawing or photographs to Mr. Rummler's satisfaction. As I understand it, he is agreeable.

Mr. Rummler: Yes, I am.

The Court: They may be received.

(The exhibit was so marked.)

431 The plaintiff rests, Your Honor.

Plaintiffs rest.

438 And on, to wit, the 27th day of May, A. D., 1940, there was filed in the Clerk's office of said Court a certain excerpt from closing argument of counsel for plaintiff, in words and figures following, to wit:

439 Now admittedly, your Honor, we have not been able to prove by direct evidence that the defendant's motor is one in which there would be those pulsations if a straight pipe were used, but plaintiff's practical expert, Mr. Irgens, the patentee of this patent, has testified

that when he was developing the device of the patent he was working with a motor which had substantially the characteristics of defendant's motor, and that consequently he believes that that pipe would have those same destructive pulsations but for the use of the tapered pipe, and I submit that that is probably true because I cannot conceive that the defendant in this case would go to added expense over a period in excess of five years and run the risk of litigation to use that pipe merely for the sake of its appearance, if it was merely the appearance that they wanted.

I might say further that even there, their reasons or their explanation is hardly a justifiable one because in the appearance they have adopted substantially the appearance of the plaintiff's exhaust pipes which were on the market prior to the time the defendant entered the field, as shown by the catalogue exhibits, Plaintiff's Exhibits 22, 23 and 24.

440 But the first claim does not contain that limitation in any event, and in each instance the defendant is using a tapered exhaust pipe, and presumably for the same purpose as the patent in suit uses that type.

Filed Feb. 9, 1940. 441 And on, to wit, the 9th day of February, A. D., 1940, there was filed in the Clerk's office of said Court a certain Decision in words and figures following, to wit:

442 DECISION.

Barnes, J. (Orally): We have had considerably longer oral arguments than we usually have in these cases, but I think the time has been well spent. It goes without saying that I am grateful to counsel for their careful preparation and their expeditious presentation of this case.

The first patent which I will discuss is that of Johnson No. 1,716,962, issued June 11, 1929, on an application filed August 25, 1926. Claims 11, 12, 13 and 14 are in suit.

It is contended by the defendant that claims 11 and 12 are not infringed because the motor of defendant's device is not mounted on the upper end of the drive shaft casing. I think probably the defendant has the better of that argument. In the sense which is pointed out by Mr. Wheeler, defendant's motor is mounted on the upper end of the drive shaft casing, but the disclosure of the patent shows

a motor mounted on the upper end of the drive shaft casing in an altogether different way and in a way which the defendant does not use. So I think the defendant has the better of that argument.

443 I think claims 13 and 14 are infringed by the two motors of the defendant, the 9-horsepower motor and the 16-horsepower motor, and, if I am mistaken about the question as to whether or not the defendant's motor is mounted on the upper end of the drive shaft casing, then claims 11 and 12 are infringed.

The defendant cites against the Johnson patent No. 1,716,962 a number of patents, Smith No. 1,226,400; Echard No. 463,386; that is the French patent as I recall; Stockemann No. 1,131,287; Johnson patent No. 1,559,616; Ducassou No. 1,034,987; Saunders (British) patent No. 179,607, of 1921; Mandl, which is a German patent, I think, No. 345,103; Lanchester (British) patent No. 14,792, of 1902; Pierce patent No. 1,579,834, and Cowles patent No. 1,234,293.

Particularly, the defendant says that this Johnson patent discloses aggregation and, in view of the patents cited, particularly Smith No. 1,226,400 and Echard No. 463,386, I think he is right. I think the patent discloses aggregation.

There has been some emphasis laid upon the claimed combination of a "housing having unbroken outer wall surfaces at each side, extending upwardly from said barrel-like portion to said plate and from said
444 plate upwardly a substantial distance to the top of the housing." That language is from claim 12.

In claim 14 is found this language: "said casing having smooth and unbroken walls extending upwardly and provided with an integrally cast anti-cavitation plate substantially midway of its height."

I cannot see any invention in casting an anti-cavitation plate integrally with the housing. I cannot see any invention in that. But it is stated, and in argument some emphasis is placed on this, that some new result is brought about by the combination of those stream lined sides of the housing and the anti-cavitation plate. I cannot see it. I think the stream lining does there what it is always intended to do, to permit a solid to pass through a liquid with the least possible friction and least resistance. I do not know how you engineers would express it, but that is what it seems to me it is intended to do, and that is ex-

actly what the stream lining does here. The anti-cavitation plate is intended to act as a baffle to prevent air being pulled down by the passage of the water through the propeller, and that is what the anti-cavitation plate does here. They both perform the functions which

445 they have always performed and, as far as I can see, in the same way. There is nothing new about what the two elements do here, and there is nothing new about the result which they bring about.

I think the patent discloses aggregation and that it is invalid.

The next patent to which I will refer is Johnson No. 1,763,970. That patent was issued June 17, 1930, on an application filed June 18, 1928. Claims 3 and 14 are in suit.

It is not contended, as I understand, that defendant's 9-horsepower motor infringes, but it is contended by the plaintiff that defendant's 16-horsepower motor does infringe both of these claims.

Claim 3 calls for:

"A propeller carrying casing for a propulsion device of a water vehicle having an anti-cavitation plate directly overlying the path of travel of the propeller blades, and lying below the water level, said casing having a portion projecting above the water level of substantially symmetrical knife-edge or wedge-like stream line contour and having a portion below said anti-cavitation plate, the front vertical edge of which is of substantially bluntly rounded stream line contour and the trailing edge of which is substantially knife-edge or wedge-like stream line contour."

Defendant's casing below the anti-cavitation plate is not bluntly rounded. No part of it is bluntly rounded. All of it has a knife-edge.

446 Claim 14 reads as follows:

"A propeller carrying casing for a water propulsion device having its upper portion adapted to project above the normal water level, said casing being of stream line contour from to to bottom; and that portion below the normal water level having its front edge of bluntly rounded stream line contour with a trailing edge of substantially knife-edge stream line construction."

As I said before, no part of the front edge of the defendant's casing is of bluntly rounded stream lined

contour. It all has a knife-edge as that word is used in the art.

Defendant cites against this patent the following patents:

Echard	No. 493,386
Ducassou	No. 1,034,987
Pierce	No. 1,579,834
Evinrude	No. 1,524,857
Grass	No. 1,639,339
Smith	No. 1,226,400
Lanchester (British)	No. 14,792 of 1902
Saunders (British)	No. 179,607 of 1921

Nobody, prior to Johnson No. 1,763,970, showed the casing with stream lined contour, having a knife-edge in the front above an anti-cavitation plate cast in the
447 housing and of stream lined contour below the anti-cavitation plate, with a bluntly rounded contour in front.

That claim may be valid, but I doubt it.

Others have shown the use of stream lining with knife-edge and with bluntly rounded contour, as I recall, but I cannot remember this particular combination. I do not know what new results that combination gets. I think maybe some of the experts said you get excellent results from that sort of thing, but just what it is I do not know, but I think claim 14 is anticipated. I think that is pure aggregation. I do not believe either of those claims is valid. There may be some doubt about claim 3, but I think I will cast my vote for invalidity. That is the best judgment I have at the moment, anyhow.

The next patent is Pierce Reissue No. 18,118. Claim 19 is in suit. That claim reads:

"An outboard motor assembly wherein the propeller carrying member forms a rudder for steering and is of stream line construction throughout its height and extends to above the water line."

I think both of the defendant's motors, the 9-horse power and the 16-horse power motor infringe, and that defendant's argument as to the invalidity of that reissue is
448 sound. I cannot see anything wrong with it.

Against that patent the defendant cited Grass patent No. 1,639,339, Echard No. 463,386, Saunders (British) No. 179,607, of 1921, Lanchester (British) No. 14,792, of 1902, and Ducassou No. 1,034,987.

In this Echard (French) patent the propeller carrying

member forms a rudder for steering. It is of stream lined construction throughout its height. It does not extend above the water line, but if that is an advantage I do not see why it would not occur to a mechanic who wanted to get more purchase on his rudder. It seems to me that Grass No. 1,639,339, anticipates, and I think that is a proper reference as against this claim.

That device shown in Saunders (British) patent is a queer looking thing, but it is an outboard assembly wherein the propeller carrying member forms a rudder for steering and it is of stream lined construction throughout its height. It does not extend above the water line, perhaps because it is fastened to the bottom of the boat.

Lanchester (British) patent No. 14,792 again discloses another queer looking device. Claim 19 reads on it. I think the claim is invalid.

449 The next patent that was considered in argument, as I recall, was the Arndt patent No. 1,875,912. That patent was issued September 6, 1932, on an application filed January 30, 1928, and claim 16 is in suit. That claim reads:

"In an outboard motor, a submersible unit having stream lined exterior surfaces converging forwardly and including a water passage having an inlet disposed at the forward apex of said surfaces within the zone of pressure created in the movement of said unit, the apex of said surfaces being linear in an upright direction and said inlet being transversely narrow and vertically elongated whereby pressures thereon will be approximately uniform throughout the area of said inlet."

Now I will have to confess to you gentlemen that I have felt during these days that we have been working over these patents that we were certainly considering the minutiae of that industry. That claim, it seems to me, certainly descends to the minutiae of this art. I think I have a right, and should take that into account in determining how broadly these claims are to be construed.

The Echard patent, to which we have referred, is cited against Arndt, Echard No. 463,386. That has an opening on the front of the lower part of the casing, but apparently, from the patent drawing, it has something like a round hole in the front there. That furnishes an intake for
450 a pump. It is just about in the same place in the casing as the opening in the Arndt patent, but the Arndt opening is of a different shape. My recollection is

that the opening is just about in the same place in the casing. The only difference is that the claims call for,—oh, it has a great lot of adjectives, "including a water passage having an inlet disposed at the forward apex of said surfaces within the zone of pressure created in the movement of said unit, the apex of said surfaces being linear in an upward direction." Now that is all found in Echard, to which I have referred, "and said inlet being transversely narrow and vertically elongated whereby pressures thereon will be approximately uniform throughout the area of said inlet." That, perhaps, is not found in Echard.

My attention was called to Evinrude No. 1,567,127. Counsel for defendant said that he desired me to look at that in order to determine the state of the art, because the patent was not cited in the answer. I do not believe that is very helpful; I do not think that helps us at all. It only distracts our attention.

Counsel also cited Pierce No. 1,579,834. Well,
451 there is an intake in just about the place that the patent in suit discloses. Counsel for plaintiff says that opening is elongated horizontally, if I understand his argument. I hesitate to disagree with him, but on looking at Figure 1, as well as at Figure 3, I am inclined to think that opening is about circular. If one may judge from a patent drawing, and I understand that is not often a safe thing to do, that opening is about one and a half times as long vertically as it is horizontally.

These matters I am talking about and have been talking about for the last few minutes, I think indicate that this claim must be narrowly construed, and we cannot go out of our way to find infringement.

Claim 16 says "and including a water passage having an inlet disposed at the forward apex of said surfaces."

Defendant does not have its inlet at the forward apex of said surfaces and considering that claim narrowly, as I think I should, the defendant does not infringe.

The next patent that will engage our attention is Evinrude No. 1,786,835, issued December 30, 1930, on an application filed October 20, 1928. Claims 1, 4, 5, 8, 9
452 and 10 are in suit.

I will just tell you shortly that I think claims 1, 4, 8 and 9 are infringed and that claims 5 and 10 are not infringed.

One element of claim 5 is, "the vanes having wiping

contact with the peripheral wall for a portion of its angular extent."

Defendant does not have that.

One element of claim 10 is, "a water supply passage partitioned from said drive shaft in a forward portion of said housing and leading to said chamber from a point therebeneath."

If in these matters, gentlemen, we are not descending to minutiae, then I am mistaken, but the defendant does not have that.

Against this patent the defendant cites Pierce No. 1,579,-834, Mandl (German) patent No. 345,103, Ziegenspeck (Swiss) patent No. 58,818, Cowles patent No. 1,234,293, Echard (French) patent No. 463,386, Szekely No. 1,295,234, Butler No. 1,274,678, and Applin No. 1,366,149.

I think Echard, Mandl and Pierce are directly in point. Szekely, Butler and Applin show a sort of pump which is disclosed by the patent.

453 I think this patent again merely aggregates what was old in the art and I think the claims are invalid.

The sixth patent which we will consider is Irgens No. 1,869,749. I am not certain about that patent. Up until today I was inclined to think that patent was valid and infringed, but counsel for the plaintiff, with characteristic candor, said, or I understood him to say, that they were not certain this patent was infringed, but they thought, everything considered, it ought to be.

Now I may be mistaken, but when I looked at these patents which are cited as prior art, I thought anybody who was trying to do what Mr. Irgens was trying to do when he looked at Hardy No. 1,169,030, would get some ideas. That is just what I thought. I thought he would get some ideas from Hardy if he looked at Hardy. Hardy has a truncated cone, and I think one of the other of the patents had the same thing. It seems to me it would occur to Mr. Irgens, "maybe there is something to that cone idea."

Perkins No. 1,131,862 and Miller No. 1,073,920 show under-water exhausts, as I recall. Hardy shows some truncated cones in series. Patch No. 1,357,079, Gray

454 1,656,629, are also cited and Stranahan No. 1,697,794 was cited.

I have some doubt as to whether those claims are definite enough. They tell what is to be done "whereby to eliminate back pressure from said pipe," that is No. 1, "the tapering form of said pipe being adapted to destroy its

resonance to pulsation frequency." There is nothing said about length, but I am going to hold that patent is not infringed. I think that is as far as I want to go.

Johnson patent No. 2,067,533 is the last patent in suit. There are a number of patents cited against that, but somehow I do not think any citation is necessary. I do not think there is any invention involved in or disclosed by that patent. I guess the defendant infringes. The defendant infringes that patent, but that patent is invalid. There is no invention disclosed.

I may reiterate that I think we have been dealing with minutiae. I do not believe these patents disclose any great forward steps, or any steps of any considerable importance in the industry. The industry is apparently an old one. There has been a lot of work done in it.
455 Pioneering is over and now the persons laboring in it, it seems to me, are spending their time on minutiae.

It did seem to me that possibly there was an idea in that exhaust, but I will confess to you that is the only place I saw any possibility.

Counsel for the defendant may, within ten days, prepare, and within like time and on notice present, findings of fact and conclusions of law and a decree not inconsistent with what I have stated.

Counsel for the respective parties may take and keep, subject to the order of Court, the exhibits of their clients.

Barnes,
Judge of the United States District Court.

503 PLAINTIFF'S EXHIBIT 21.

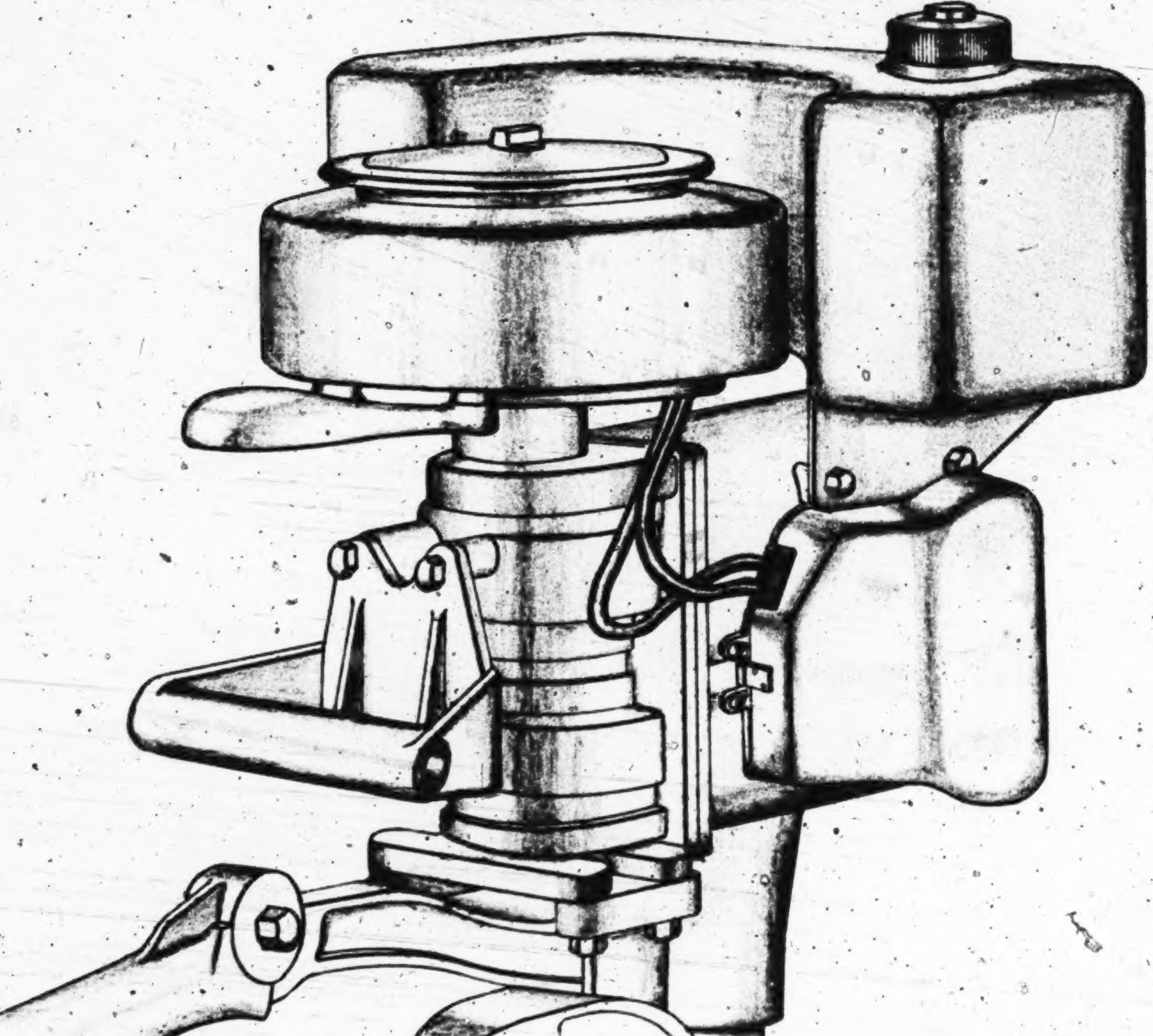
Johnson Division.

	Domestic and Export		Streamlined Motors		
Year	Total Motors	List Value	Total Motors	List Value	% of Total with Streamline
1926	14,417	2,161,436.00	2,500	494,990.00	17.3
1927	21,546	3,377,655.00	20,564	3,265,645.00	95.5
1928	25,653	4,358,070.00	24,425	4,216.850.00	95.3
1929	30,110	6,302,815.00	28,253	6,089,260.00	94.0
1930	25,259	5,413,035.00	23,367	5,176,535.00	92.2
1931	10,325	1,738,257.00	9,649	1,660,517.00	93.2
1932	7,979	1,304,172.50	7,491	1,248,052.50	92.0
1933	8,060	973,300.50	5,535	794,152.50	68.6
1934	9,627	1,213,418.00	4,435	729,052.00	46.0
1935	12,055	1,533,598.50	11,182	1,465,013.50	92.7
1936	20,868	2,209,941.00	20,758	2,201,141.00	99.4
1937	29,452	3,374,347.00	29,452	3,374,347.00	100
1938	30,279	3,261,560.00	30,279	3,261,560.00	100
1939	40,800	4,340,992.00	40,800	4,340,992.00	100
Total	286,434	41,562,597.50	258,694	38,318,107.50	

Evinrude Division.

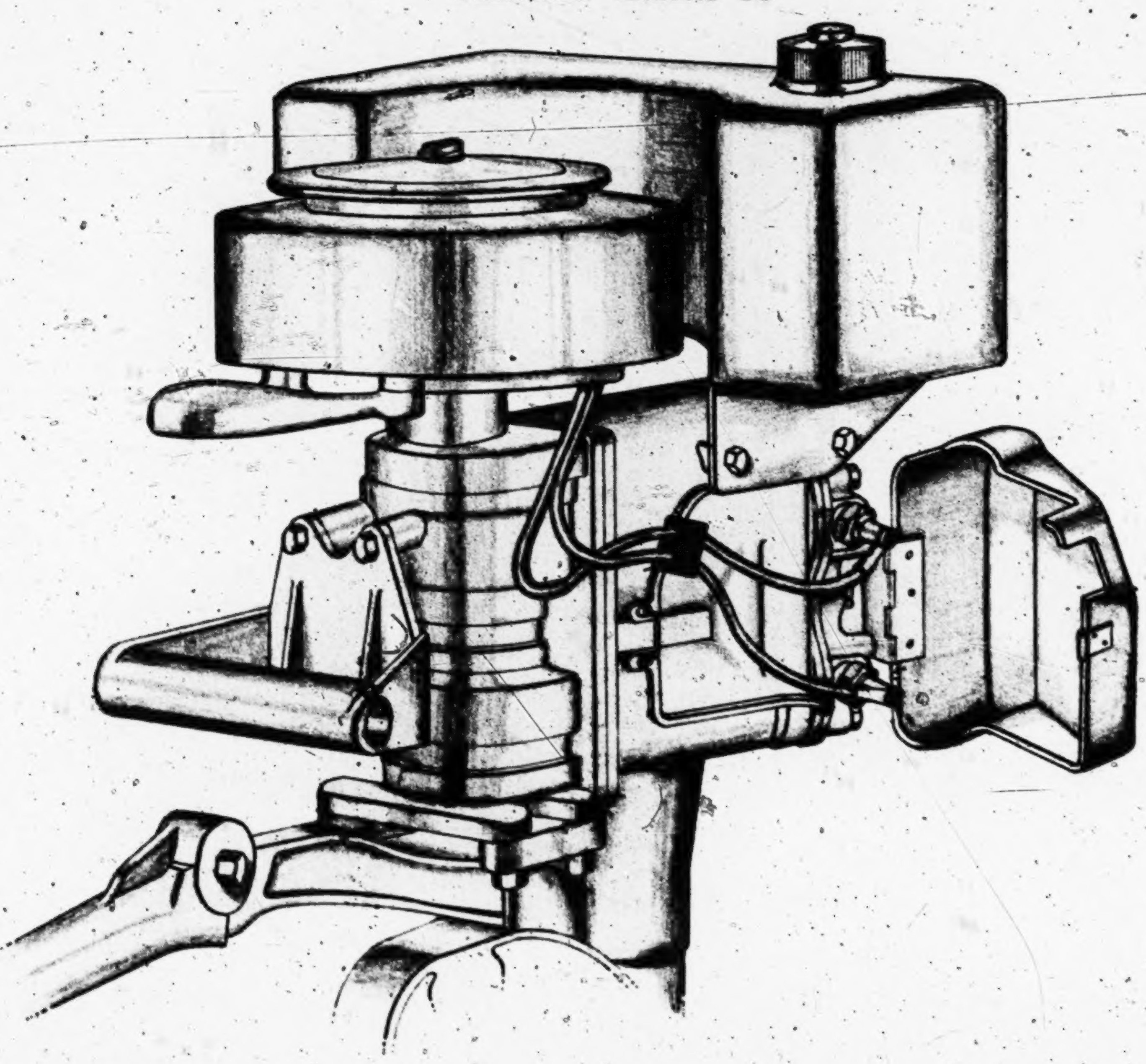
1926	11,589	1,680,405.00			
1927	17,746	2,771,290.00	9,079	1,523,235.00	51
1928	23,954	4,411,480.00	20,600	3,933,410.00	81
1929	23,193	4,285,540.00	22,593	4,198,540.00	97.3
1930	14,219	2,970,460.00	10,737	2,465,570.00	75
1931	12,775	2,010,282.65	10,936	1,825,703.90	85
1932	8,391	1,081,738.55	5,183	814,148.70	61
1933	7,962	930,476.75	4,291	630,603.15	53
1934	8,792	1,145,043.95	4,805	785,139.10	54
1935	17,594	1,578,677.85	4,176	676,185.00	23
1936	25,010	2,272,690.10	5,004	878,114.85	21
1937	39,912	3,309,342.50	7,060	1,302,141.75	18
504					
1938	38,550	3,149,806.10	5,592	1,093,928.75	15
1939	50,206	3,877,967.05	10,394	1,690,100.85	21
Total	299,893	35,475,200.50	120,450	21,816,821.05	40%

Plaintiffs' Exhibit 30



DEFENDANT'S MOTOR
SPARK PLUG COVER CLOSED

Plaintiffs' Exhibit 30



DEFENDANT'S MOTOR
SPARK PLUG COVER OPEN

508 And on, to wit, the 27th day of May, A. D. 1940 came the Defendants by their attorneys and filed in the Clerk's office of said Court their certain Exhibit "A," portions of which are as follows:

(Here appear patents. See index.)

635 316 Dynamic Pressure of Flowing Water.

[Chap. XI.

Article 132. Immersed Bodies.

When a body is immersed in a flowing stream, or when it is moved in still water, so that filaments are caused to change their direction, a dynamic pressure is exerted or overcome. The theoretic determination of the intensity of this pressure is difficult, if not impossible, and will not be here attempted;

in fact, experiment alone can furnish reliable conclusions. It is, however, to be inferred from what has preceded, that the dynamic pressure

FIG. 91.

in the direction of the motion is proportional to the force of impulse of a stream whose cross-section is the same as that of the body, or

$$P = m \cdot wa\frac{v^2}{2g},$$

in which m is a number depending upon the length and shape of the immersed portion, and whose value is 2 for a jet impinging normally upon a plane.

Experiments made upon small plates held normally to the direction of the flow show that the value of m lies between 1.25 and 1.75, the best determinations being near 1.4 and 1.5. It is to be expected that the dynamic pressure on a plate in a stream would be less than that due to the impulse of a jet of the same cross-section, as the filaments of water near the outer edges are crowded sideways, and hence do not impinge with full normal effect, and the above results confirm this supposition. The few experiments on record were made with small plates, mostly less than 2 square feet area, and they seem to indicate that m is greater for large surfaces than for small ones.

The determination of the dynamic pressure upon the end of a cylinder, as at B in Fig. 91, is difficult because of the resisting friction of the sides; but it is well ascertained to be less than that upon a plane of the same area, and within certain limits to decrease with the length. For a conical or wedge-shaped body the dynamic pressure is less than that upon the cylinder, and it is found that its intensity is much modified by the shape of the rear surface.

636, 318 Dynamic Pressure of Flowing Water.

[Chap. XI.

When a body is so formed as to gradually deflect the filaments of water in front, and to allow them to gradually close in again upon the rear, the impulse of the front filaments upon the body is balanced by the reaction of those in the rear, so that the resultant dynamic pressure is zero. The forms of boats and ships should be made so as to secure this result, and then the propelling force has only to overcome the frictional resistance of the surface upon the water.

The dynamic pressure produced by the impulse of ocean waves striking upon piers or lighthouses is often very great. The experiments of Stevenson* on Skerryvore Island, where the waves probably acted with greater force than usual, showed that during the summer months the mean dynamic pressure per square foot was about 600 pounds, and during the winter months about 2100 pounds, the maximum observed value being 6100 pounds. At the Bell Rock lighthouse the greatest value observed was about 3000 pounds per square foot. The observations were made by allowing the waves to impinge upon a circular plate about 6 inches in diameter, and the pressure produced was registered by the compression of a spring.

Prob. 158. Compute the probable dynamic pressure upon a surface one foot square when immersed in a current whose velocity is 8 feet per second, the direction of the current being normal to the surface.

637 124 Speed and Power of Ships

3. Resistance of Struts.—Probably struts and spectacle frames are the appendages to which the most careful attention must be paid from the point of view of resistance. Experiments with a number of strut arms of elliptical section appear to indicate that the resistance in pounds per foot length may be expressed with fair approximation for areas from 40 square inches to 175 square inches by the following semi-empirical formula:

$$R = \frac{C}{1000} (A + 40) V^2.$$

* Rankine's Civil Engineering, p. 756.

Where R is resistance in pounds per foot length, V is speed through the water in knots and A is area of cross section of strut in square inches. The coefficient C depends upon the ratio between B, the thickness of the strut section, and L, its width in direction of motion. The table below gives values of C for various values of $\frac{L}{B}$.

$\frac{L}{B}$	3	4	5	6	7	8	9	10	11	12
C	1.880	1.318	1.073	.940	.858	.801	.762	.736	.720	.714

From the point of view of resistance only, the best ratio of breadth to thickness would be 10 or over, but as the wide, thin strut requires more area for a given strength, it follows that the best all-round ratio would be somewhat smaller, say from 7 to 9.

Even this ratio is not very often reached in practice, the tendency apparently being to make strut arms much narrower and thicker than they should be.

As regards shape of section, model experiments indicate that a pear-shaped section, or a section of rounding forward part and sharp after part, offers the least resistance. Such a section may show model resistance as much as 10 per cent below the elliptical section.

There is doubt, however, whether this holds for full-sized struts for high-speed vessels. Study of Fig. 16 would seem to indicate that at sufficiently high speeds there must be eddying over all the rear half of any strut, in which case the thickness of the strut should be reduced to a minimum. From this point of view, if a strut of given width and area is to have the minimum thickness for a given type of head the rear portion should be made of parallel thickness and cut off square. Furthermore, from this point of view, if air were piped to the rear of a strut the resistance would be decreased. This question of strut resistance is worthy of further careful experimental investigation. Pending this, the approximate formula and coefficients above for elliptical struts may be used, and it may be assumed that the

elliptical form is about as good as any. For moderate speeds the rear portion of the strut may be brought to a sharp edge, but for high speeds this refinement will probably be of little use.

4. Resistances of Propeller Hubs.—Behind the strut hub the propeller hub is fitted, and for propellers with detachable blades is usually larger than the strut hub. About all that can be done for the propeller hub is to fit a conical fair-water behind it. Model experiments show that a long fair-water, say of length about twice the diameter of the propeller hub, offers materially less resistance than a short fair-water of length say about one-half the diameter of the propeller hub.

While there is some doubt whether the long fair-water would show up so well in comparison on the full-sized ship, the length of fair-water should not be skimped.

FIG. 3 A SOURCE IN A UNIFORM STREAM

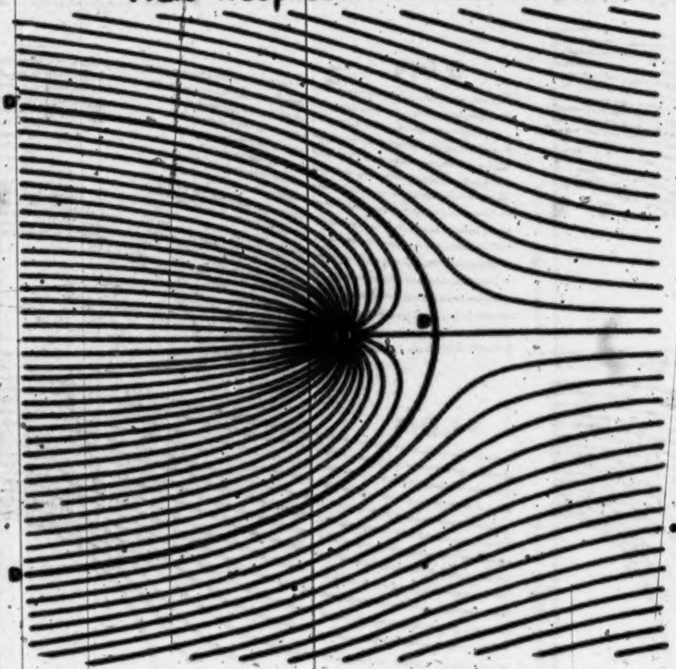
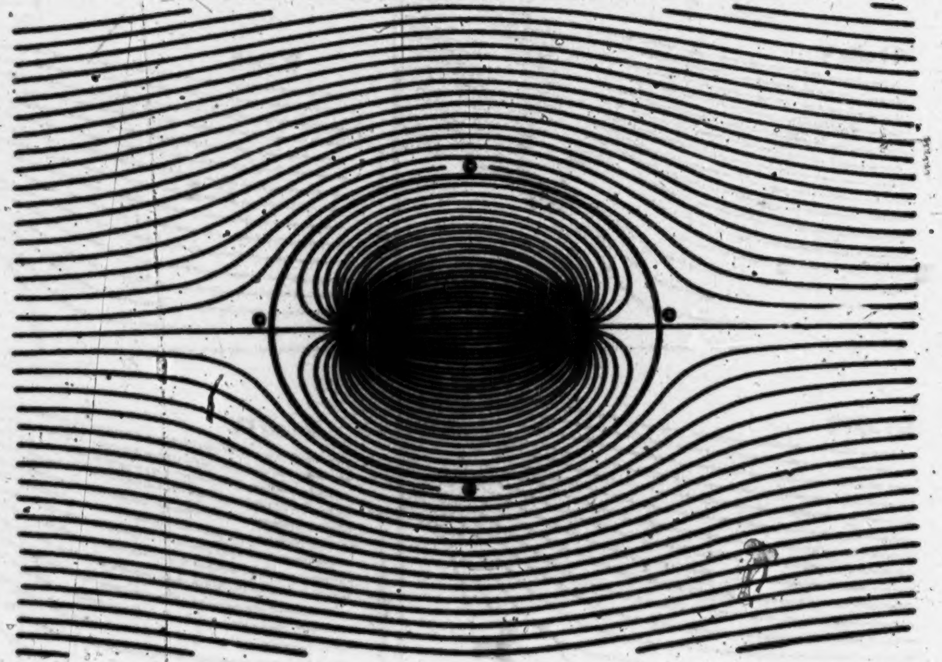
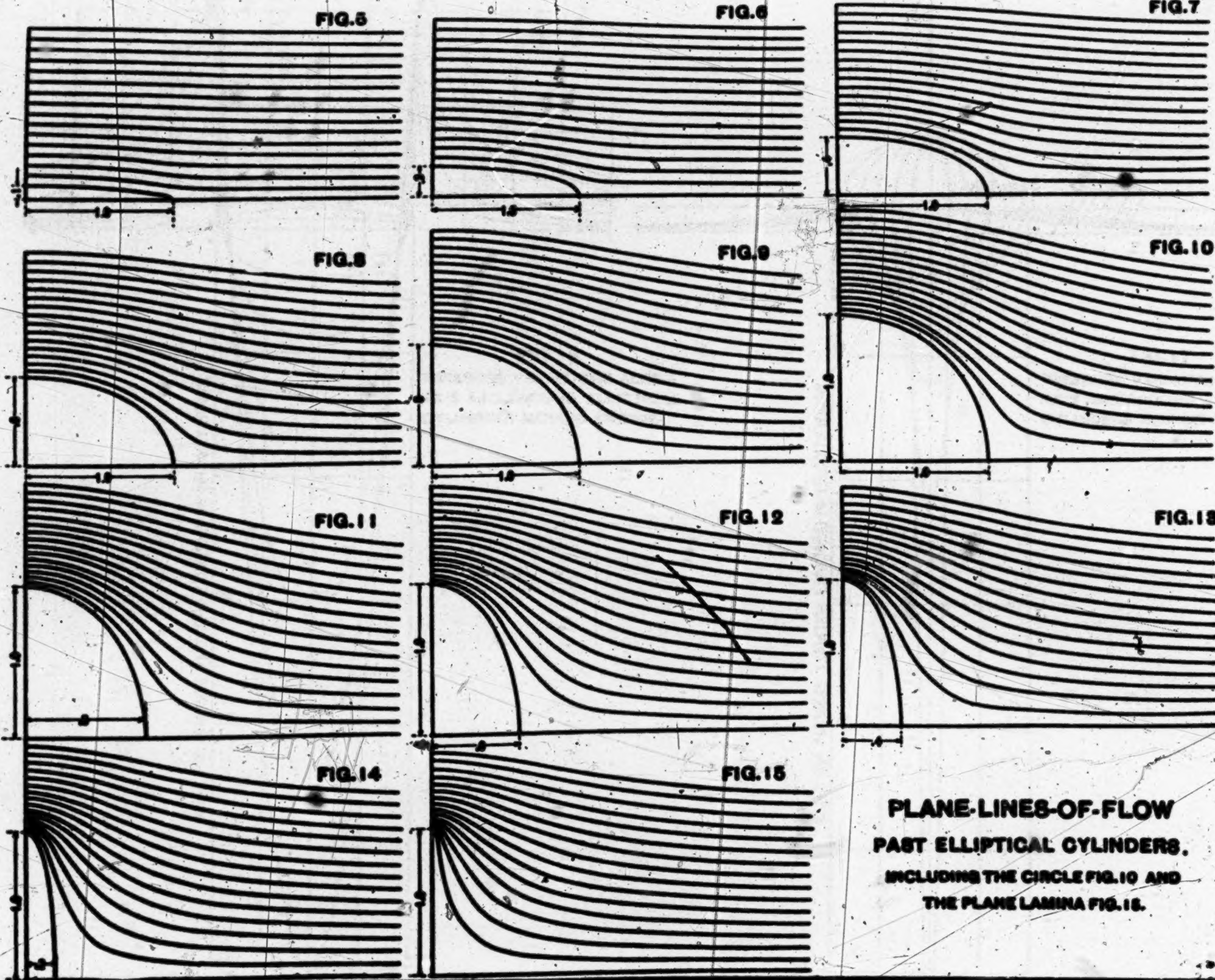


FIG. 4 A SOURCE AND A SINK IN A UNIFORM STREAM



FIGS. 5-15



PLANE-LINES-OF-FLOW
PAST ELLIPTICAL CYLINDERS,
INCLUDING THE CIRCLE FIG. 10 AND
THE PLANE LAMINA FIG. 15.

FIGS.16-17

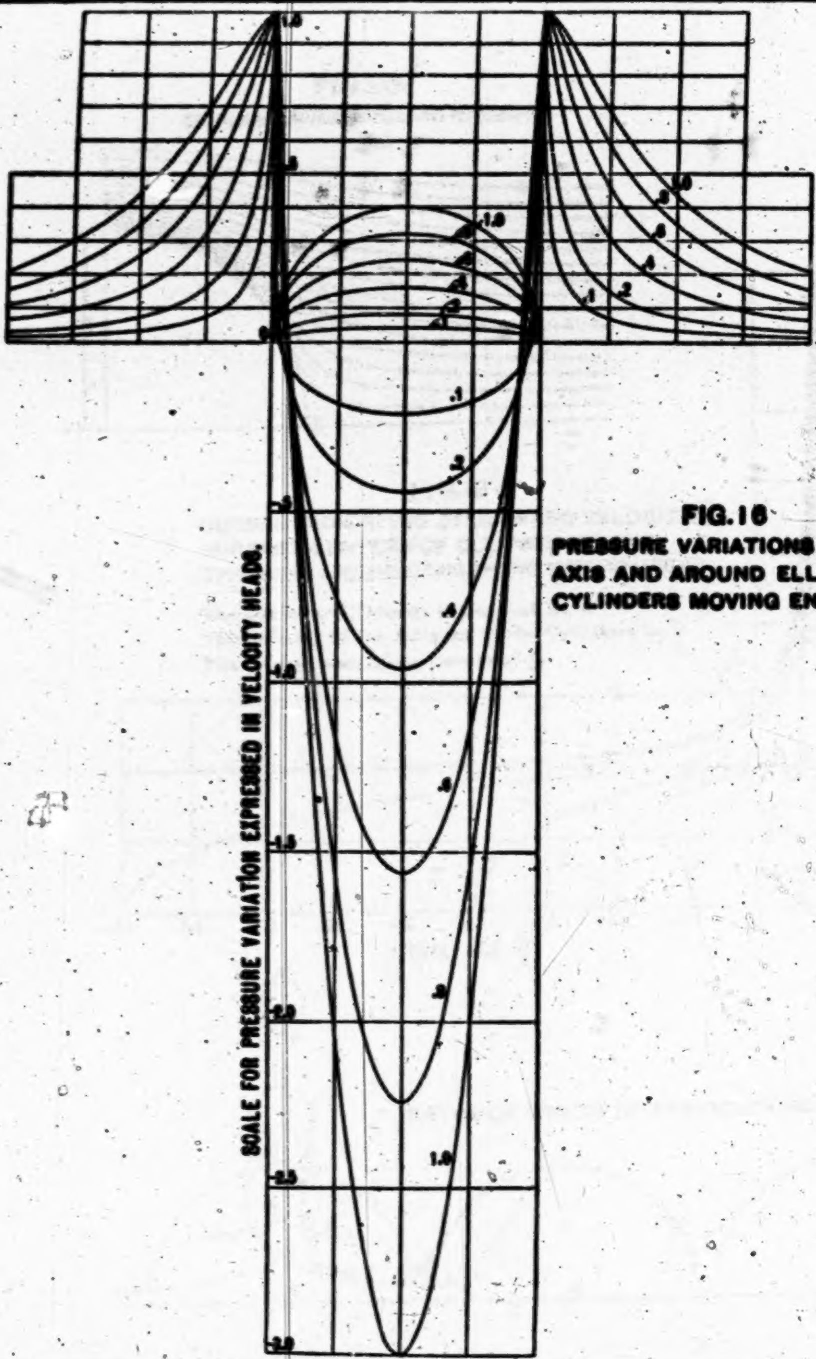


FIG.16
PRESSURE VARIATIONS ALONG AXIS AND AROUND ELLIPTICAL CYLINDERS MOVING ENDWISE.

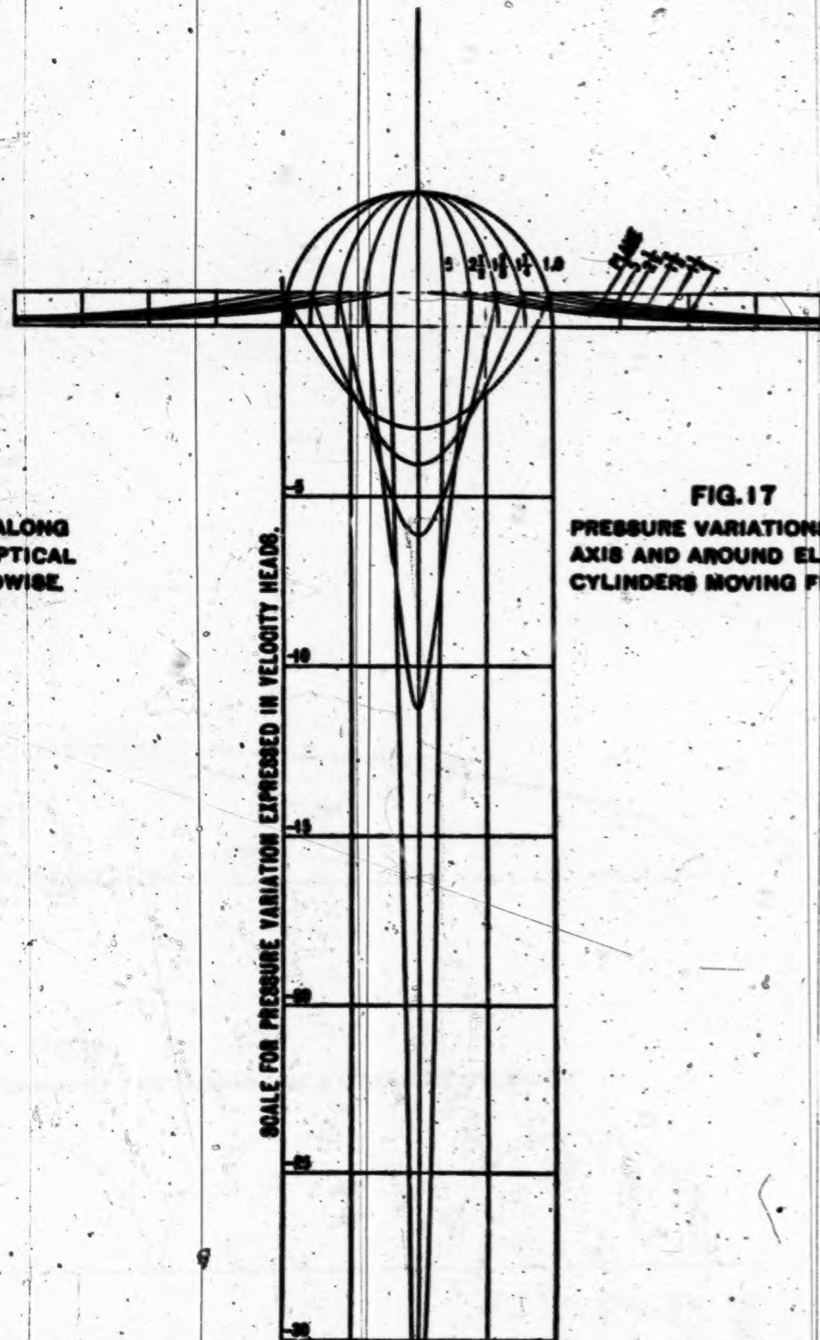


FIG.17
PRESSURE VARIATIONS ALONG AXIS AND AROUND ELLIPTICAL CYLINDERS MOVING FLATWISE.

FIG. 20

STREAM LINES AROUND SPHERE

FIG. 18

CURVES INDICATING STERNWARD VELOCITIES ABREAST CENTERS OF ELLIPSES MOVING THROUGH LIQUID OTHERWISE UNDISTURBED.

The Sternward Velocity is Denoted by u
The Velocity of the Advance of the Cylinders by V
The Curves shown are Curves of $\frac{u}{V}$

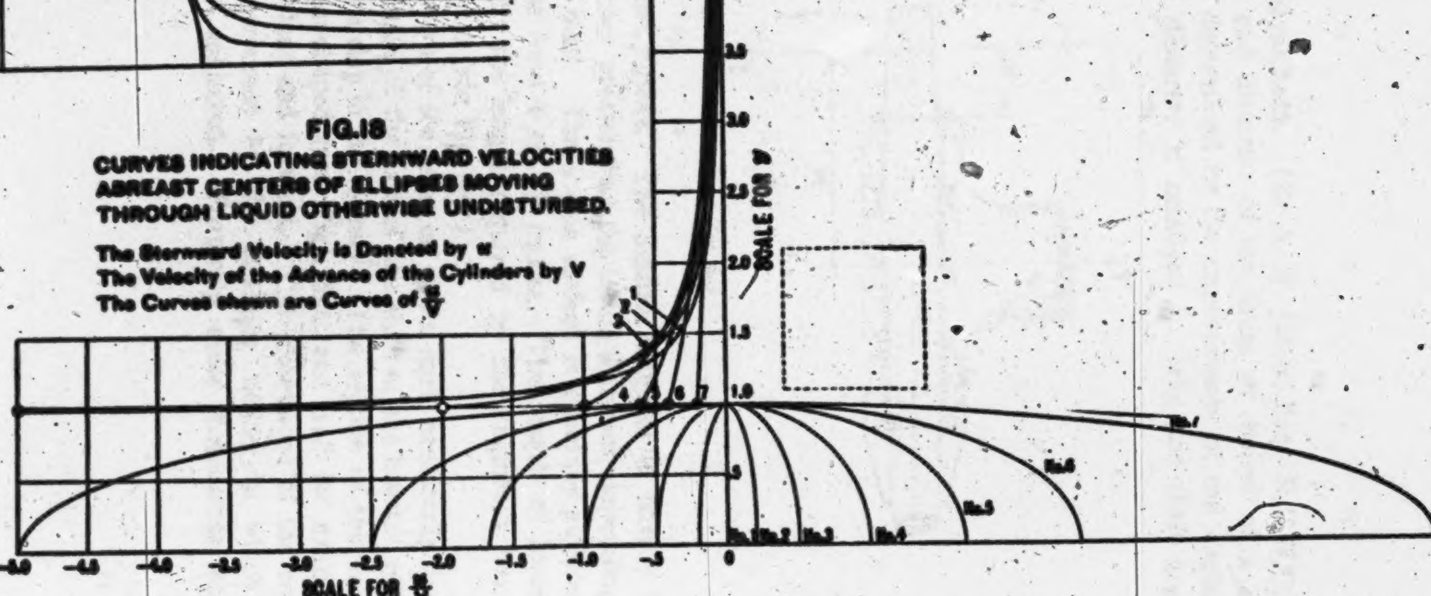
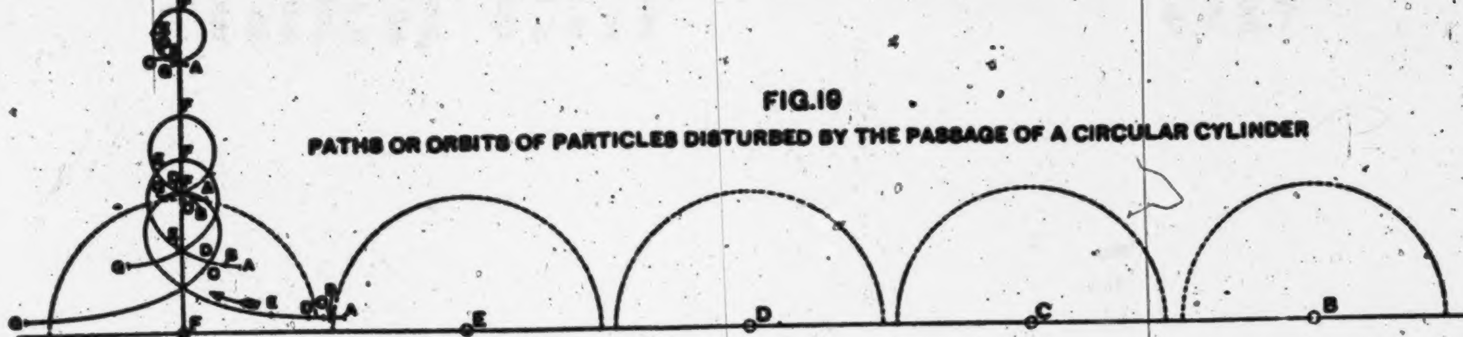


FIG. 19

PATHS OR ORBITS OF PARTICLES DISTURBED BY THE PASSAGE OF A CIRCULAR CYLINDER



Shaft Brackets. (By A. W. Johns, Esq., R.C.N.C.).—The length and diameter of the drum or barrel of a shaft bracket are determined by the requirements of the engineer. The inside diameter is arranged to take the shaft and its

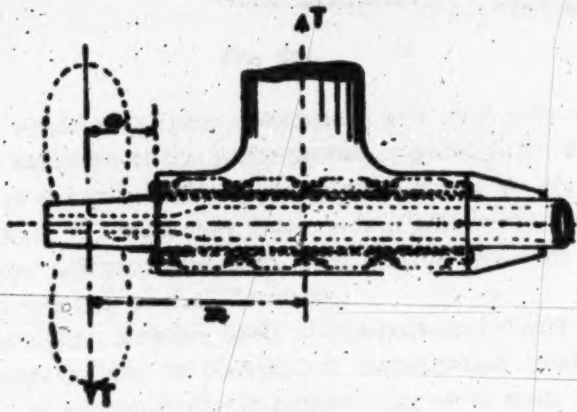


FIG. 857.

bearings and bushes. The outside diameter is usually from 3 to 6 inches greater than the inside diameter, depending on the size of shaft. The inside surface is generally gulleted to a depth of from 1 to 1½ inches. The length of barrel is governed by the length required by the engineer's bearings in the bracket (see Fig. 857).

The length of the arms or struts must necessarily depend on the position of the axis of the shaft at the bracket and the shape of the ship in the vicinity. The section of the arms is usually pear-shaped (see Figs. 850 and 108 for examples), with the blunt end forward. The dimensions of the section must be governed by the straining action to which the bracket is subjected. Formerly these dimensions appear

to have been determined in a rough-and-ready way from the experience of the designer responsible. Knowing the dimensions in previous cases which on service had proved sufficiently

Fig. 85a.

strong, he would vary these dimensions in a new ship according to the variation of the horse-power, or perhaps the size and overhang of the tail shaft. Consequently it will be found that ships of about the same size, horse-power and revolutions produced under different designers, have entirely different dimensions (and weights) of shaft brackets.

At first sight a suitable basis of comparison for such dimensions appears difficult to obtain, but investigation proves that the matter is a comparatively simple one, as is seen by what follows :—

With the centre of gravity of the revolving parts, viz. shaft and propeller, in the axis of rotation, the straining actions which may operate on a bracket are as follows, viz. :—

1. Forces due to the weight of the propeller, shaft and bracket. These are equivalent to a downward force on the bracket, and a bending moment on it, equal to the difference in the moments of weight on the forward and after sides. Both the force and the bending moment may be increased appreciably by the accelerative effect during pitching.

Thus in a given ship, 500 feet long pitching in a "single" period of 3 seconds, the maximum acceleration is $250 \times \frac{\pi^2}{T^2} \cdot \times \theta$, where θ is angle of pitching (see Chap. IX. on Rolling).

If $\theta = 4°$, say $\frac{1}{14}$ in circular measure, acceleration = 20 in foot-second units. This added to the acceleration due to gravity gives 52·2 or a *virtual* weight of 1·6 times the actual, and all the forces are increased in this ratio.

2. Forces called into play when pitching or turning due to the gyroscopic action of the propeller and shaft.

643 252. Theoretical Naval Architecture.

3. Forces caused by unequal pressure on the blades of the propeller when the ship is turning. Here, owing to the transverse motion of the stern, the forces on the blades above the horizontal will be different to those below.

If, however, the centre of gravity of the revolving weights is not in the axis of rotation, there will be in addition to the above forces a centrifugal force operating which will tend to bend the shaft where it enters the strut, and will ~~also tend to bend and twist the bracket.~~ At high revolutions, which is the case in turbine machinery, heavy straining actions are set up if a propeller blade is broken or lost.

The following are approximate values of the various ~~forces and moments~~ considered above, worked out for the case of a large cruiser.

	Force on bracket.	Moment on bracket.
(1) Due to weight of propeller, etc.......	30 tons	90 foot tons
(1a) Due to weight of propeller, etc., when pitching	48 "	144 "
(2) Gyroscopic action	—	50 "
(3) Turning at full speed with full rudder angle	12 "	80 "
(4) Centrifugal action due to the loss of a propeller blade at full revolutions..	100 "	500 "

It will be seen that the last case produces by far the heaviest straining effect. In addition to straining the bracket, however, the shaft also will be strained, the maximum stress occurring at the section immediately at the after end of the barrel of the bracket. For good design the bracket should be stronger than the shaft, for then the shaft would break at the after end of the boss of shaft bracket, whereas if the bracket were weaker than the shaft the former would first break and the shaft losing its after support would then bend or break with perhaps disastrous effect on the ship. A basis of calculation is therefore obtained by considering the strength of the shaft and making the shaft bracket somewhat stronger.

If T is the force at the propeller (Fig. 85F), producing

Calculation of Weights, etc. 253

a bending moment T . *a* on the shaft which will just bring the material of the shaft to its full working strength, this

force T must be employed in determining the dimensions of the arms of the bracket and also in determining the number, size and spacing of the rivets connecting the bracket to the hull. T acting at propeller is equivalent to—

1. A parallel force T acting directly on the bracket, and
2. A moment $k \cdot T \cdot m$ on the bracket, where k has an average value of about 0.65.

If T is caused by centrifugal action, then as the shaft revolves it is always being bent in the same way, but the bracket being fixed the force and moment on it are constantly altering in direction.[1] Bending alone occurs when the line of action of T lies in a plane passing through the axis of shaft and bisecting the angle between the arms. Twisting occurs when the line of action of T is perpendicular to that plane. For other directions of the line of action of T combined bending and twisting occur.

Generally bending alone produces the greatest stress on the shaft arms, and this produces a stress given by—

$$p = \frac{k \cdot T \cdot m \cdot y \cdot \cos\theta}{2I}$$

where I is the moment of inertia of a right section of the arm about an axis through the geometrical centre and perpendicular to the longer dimension of the section.

y is the distance of the most strained layer from this axis; and θ is half the angle between the arms.

For ordinary pear-shaped sections, $y = 0.55$ R and $I = \frac{1}{27}$. $R^3 \cdot r$, where R and r are the longer and shorter dimensions of the section of the arm.

Taking, say, 6 tons as the maximum working strength of the shaft, the force T necessary to strain the shaft to this limit can readily be found when a the overhang and D and d the external and internal diameters of the shaft are known. Supposing the shaft bracket is of cast steel and taking $4\frac{1}{2}$ tons as the working strength (5 tons is really allowed, but $\frac{1}{2}$ ton is

1. The loss of a propeller blade is soon evident, for the ship will vibrate violently if the revolutions of the engine approach the full number.

allowed for the force T acting directly on the bracket), the following relation is obtained—

$$R^2 . r = 0{\cdot}63 \times \frac{D^4 - d^4}{D} \times \frac{m}{a} \times \cos\theta \quad . \quad . \quad (1)$$

All dimensions being in inches.

Usually θ = about 45° and we then have—

$$R^2 . r = 0{\cdot}44 \times \frac{D^4 - d^4}{D} \times \frac{m}{a} \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

If, however, θ is small, we have approximately—

$$R^2 . r = 0{\cdot}63 \times \frac{D^4 - d^4}{D} \times \frac{m}{a} \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

As stated above, the stress produced on the bracket by bending is usually greater than that produced by twisting, but in the case where the angle between the arms is small the stress due to twisting should also be investigated. This can be done as follows :—

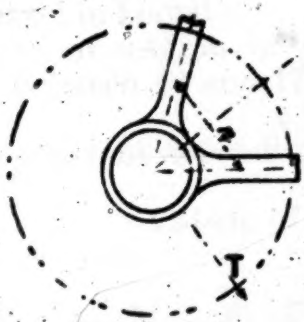


FIG. 85H.

Taking, as in the figure 85H, n as the distance between the centres of the arms, A the area of each arm, q the stress in the arm, the moment resisting twisting is given by $q . A . n$. This must equal $k . T . m$, and hence the stress due to twisting becomes

$$q = \frac{k . T . m}{A . n} \qquad (A = 0{\cdot}75R . r)$$

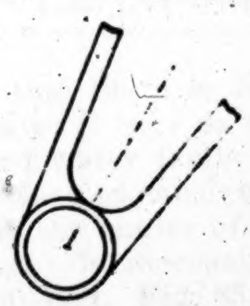


FIG. 85J.

q is a shearing stress and the equation shows that if A is constant q increases as n decreases. Close to the barrel q is a maximum, and is a minimum where the arms enter the hull. For q to be constant A should vary inversely as n. Usually, however, A is kept constant and the arms are run tangential, as in Fig. 85J, instead of radial to the barrel. This has the effect of increasing n near the barrel and diminishing q.

Equations (1), (2), and (3) above can be used to determine

the value of $R^2 r$, where the bracket is of cast steel. If the bracket is of other material the working strength of the latter must be substituted for the $4\frac{1}{2}$ tons used above.

It will be noticed that economy of material is obtained by making the ratio $R \div r$ as large as possible, for since the square of R enters into the relation it has far more influence than r, which appears in the first power only. Thus if $R^2 . r = 8000$ and $R = 3r$, then $R = 29$ in. and $r = 9\frac{3}{4}$ in. and $A = 212$. Whereas if $R = 6r$, $R = 36$ in., and $r = 6$ in., and $A = 162$ or a saving in weight of about 25 per cent. There is also an appreciable reduction in resistance. Taylor's experiments with shaft brackets show that resistance in lbs. per foot length of shaft bracket arm is given by—

$$F = \frac{c}{1000} (A + 40) V^2$$

where V = speed in knots

A = area of section in square inches, for values between ·40 and 175 sq. inches.

c = a constant depending on the ratio $\frac{R}{r}$.

Values of c.

Ratio $\frac{R}{r}$	3	4	5	6	7	8	9	10	11	12
Value of c	1.88	1.32	1.07	0.94	0.86	0.80	0.76	0.74	0.72	0.71

Further than this there is little doubt that with bracket arms whose ratio $R \div r$ is small, at high speeds a large amount of dead water trails behind the arms reaching to the propeller disc and causing vibration and loss of propeller efficiency as the blades of the propeller enter and leave the dead water. By increasing the ratio $R \div r$ these effects are diminished. Fig. 85E gives the section of the arm of shaft bracket of a recent ship of large power and great speed.

Finally it is interesting to compare the dimensions given by formula (2) above with those adopted in practice in particular cases as the result of experience. The ratio

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R $\div$ r has been kept the same in the calculation as actually adopted. All dimensions are in inches.

	D	d	m	a	Actually fitted.		Calculated.	
					R	r	R	r
Cruiser	7¾	0	37	12	14	4	13.3	3.8
"	13	9	50	21	16	6	16.8	6.3
"	16	10	56	27	20	6½	21.5	7
"	16	10	62	27	24	6	24	6
"	19½	7	78	33	28	8	30.1	8.6
"	21	11	76	30	32	10	31.2	9.8
Battleship	20	11½	72	30	27	7½	30	8.4
Destroyer	8½	4½	36	18	13	2	14.3	2.2

The relations in (1), (2), and (3) given above apply strictly to the usual pear-shaped section of arm, but the method indicated can be applied to any particular case and the dimensions calculated.

R & S Weather-Proof Type Receptacles and Plugs

2-Wire Polarized

100 Amperes, 250 Volts

Receptacle and plug are ruggedly designed, with slate interior and heavy bronze spring contacts. Plug is made of composition with a hard maple wood handle and heavy protecting sleeve.

Box and cover, japanned cast iron (galvanizing extra). Cover gasketed and provided with gasketed spring flap door. Box 8x7x3 inches deep. Outlets, 2-inch maximum conduit in any side. Specify outlets required.

Cat. No.	Description	Weight Pounds	Price Each
233	Complete with Plug	19	$33.00
234	Plug Only	2	9.90

GraybaR

R & S Angle Type Receptacles and Plugs

2, 3 and 4-Wire Polarized

15, 30 and 60 Amperes, 250 Volts

Angle Type Receptacle

An important feature of this improved line of receptacles and plugs is the provision for an additional conductor for the grounding of portable electric tools, thereby conforming with the latest regulations governing portable equipment.

Receptacle Housing

The receptacle housing is an extra heavy galvanized iron casting provided with gaskets and hinged spring flat cover, and having the following features:

Positive polarization to insure correct assembly of contact members.

Provision for grounding to meet the latest requirements.

External rib to provide visual indication for plug insertion.

Concealed hinge spring packed with grease insures positive and easy action of flap cover.

Assembly of interior parts permits full floating and self-alignment of contact members.

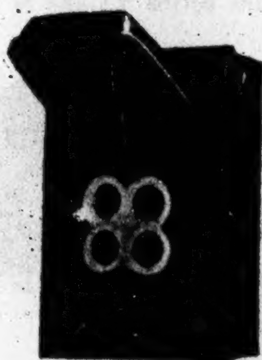
Large conduit bosses and ample space for wiring facilitate installation.

Square D Universal Meter Service Switches

Standardized—Single Phase—D.C.

30 Amperes—125 Volts—Plug Fuse—Single Phase and D.C.

2 and 3-Pole Mains, Fused and Solid Neutral Mains



Cat. No. 34311, Open

Cat. No. 33211, Main Cover Open

Descriptive wiring diagrams in each switch show the various types of installations for the respective catalogue numbers as described below.

Type FF Condulets

2 or 3-Wire, 250 Volts

These are service entrance Condulets, fusible and weatherproof. Wiring devices, pages 436 to 438, Condulet catalogue No. 2000. Take main line fuse cutouts.

The service wire enters the bottom of the fuse cutout compartment through a porcelain bushing, thus preventing grounding, even though the insulation becomes damaged.

Furnished with removable conduit hub plate, cutout fastening plate, porcelain bushings, screws and bolts, but without cutouts.

Any assortment of 50 black enameled and galvanized Condulets of the FF series will be considered a standard package.

Cat. No.	Size In.	Std. Pkg.	Wt., Lbs. Std. Pkg.	Price Each
		30 Amperes		
FF1302	½	20	260	$7.80
FF2302	¾	20	270	7.90
FF3302	1	10	140	8.00
		60 Amperes		
FF3602	1	10	150	$10.00
FF4602	1¼	10	155	10.10
		100 Amperes		
FF31002	1	10	225	$19.00
FF51002	1½	5	115	19.20
FF61002	2	5	120	19.30

Type FFA Condulets

2 or 3-Wire, 250 Volts

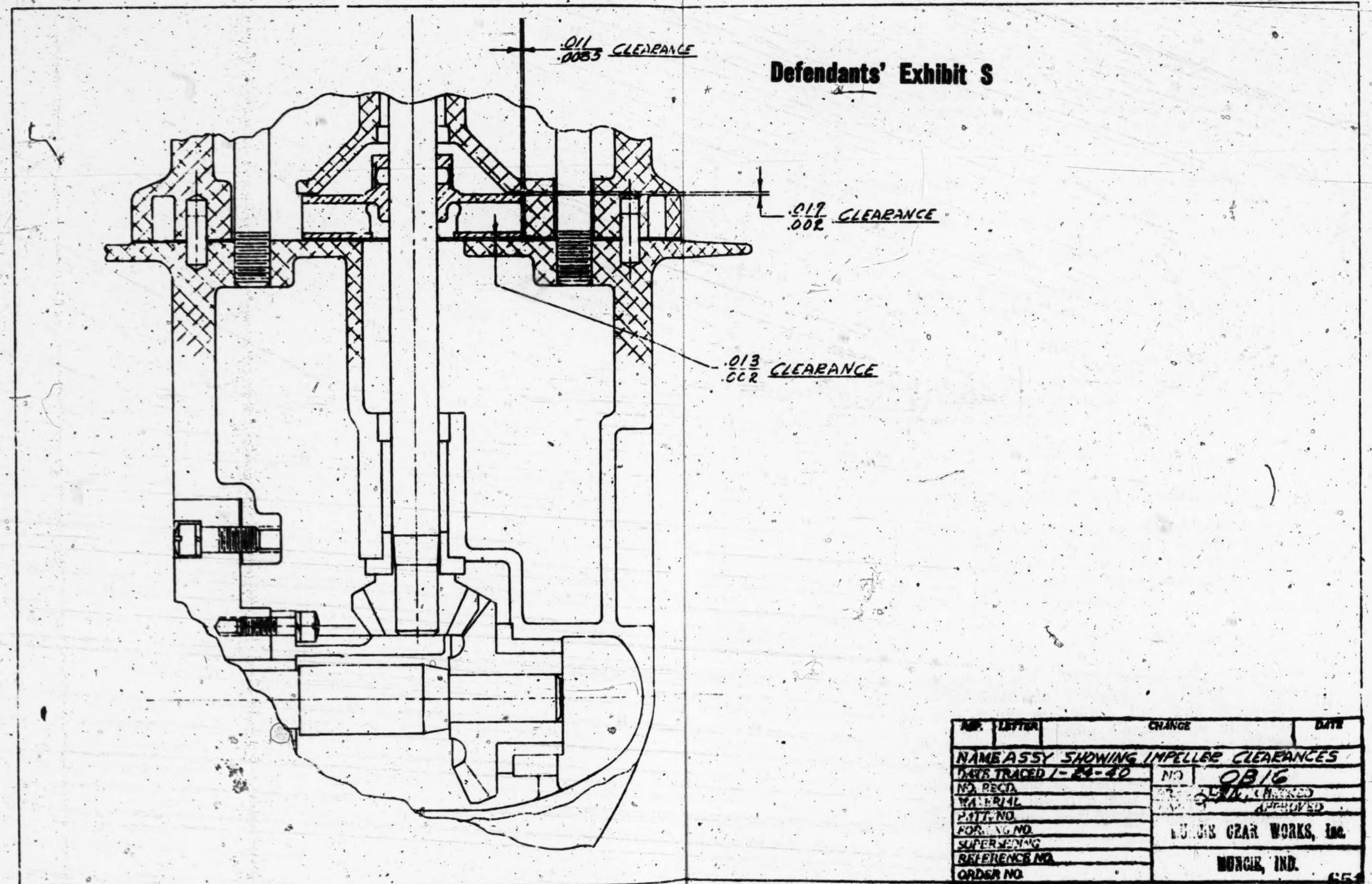
Service entrance Condulets. Take main line fuse cutouts. Wiring devices, pages 436 to 438, Condulet catalogue No. 2000.

Threaded hub for Condulet enters from rear.

Furnished with removable conduit hub plate, cutout fastening plate, porcelain bushings, screws and bolts, but without cutout.

Cat. No.	Size In.	Std. Pkg.	Wt., Lbs. Std. Pkg.	Price Each
		30 Amperes		
FFA1302	½	20	270	$7.80
FFA2302	¾	20	280	7.90
FFA3302	1	10	145	8.00
		60 Amperes		
FFA3602	1	10	155	$10.00
FFA4602	1¼	10	165	10.10

Defendants' Exhibit S



456 And afterwards, to wit, on the 20th day of February, A. D., 1940, being one of the days of the regular February term of said Court, in the record of proceedings thereof, in said entitled cause, before the Honorable John P. Barnes, District Judge, appears the following entry, to wit: Filed Feb. 20, 1940.

457 In the District Court of the United States

For the Northern District of Illinois,

Eastern Division.

Outboard, Marine & Manufacturing Company, a corporation of Delaware,
Plaintiff,
vs.
Muncie Gear Works, Inc., a corporation of Indiana, and Bruns & Collins, Inc., a corporation of Illinois,
Defendants.

Civil Docket No. 273.

FINDINGS OF FACT AND CONCLUSIONS OF LAW.

This cause having come on to be heard and having been tried on January 25, 26, 29, 30, 31 and February 1, the Court after due consideration enters the following Findings of Fact and Conclusions of Law pursuant to Rule 52-a of the Rules of Civil Procedure.

Findings of Fact.

1. By stipulation and order, cause 273, Outboard Marine and Manufacturing Company *vs.* Muncie Gear Works, Inc., and Bruns & Collins, Inc., and cause No. 274, Johnson Bros. Engineering Corporation and Outboard Marine and Manufacturing Company *vs.* Muncie Gear Works, Inc., and Bruns & Collins, Inc., were consolidated at the beginning of trial and the consolidated cause proceeded under the title and number of Cause No. 273, Outboard Marine and Manufacturing Company

vs. Muncie Gear Works, Inc., and Bruns & Collins, Inc.

2. This Court has jurisdiction over all the parties and of the subject matter of the complaints herein.

458 3. Plaintiff, Outboard Marine and Manufacturing Company is the owner of the following United States Letters Patent:

Pierce	Re 18,118	issued	July	7, 1931
Evinrude	1,786,835	"	Dec.	30, 1930
Irgens	1,802,652	"	Apr.	25, 1931
Irgens	1,869,749	"	Aug.	2, 1932
Arndt	1,875,912	"	Oct.	31, 1933

Ownership of the whole right, title and interest in each of the aforesaid patents other than Pierce Re 18,118 has been, as above stated, throughout the period of alleged infringement of each of said patents. Pierce Re 18,118 was assigned to plaintiff, Outboard Marine and Manufacturing Company during the period of alleged infringement, together with all rights of action for recovery for past infringement.

4. At date of commencement of this suit Plaintiff, Johnson Bros. Engineering Corporation was sole owner and plaintiff, Outboard Marine and Manufacturing Company was exclusive licensee of the following United States Letters Patent:

Johnson	1,716,962	issued	June	11, 1929
Johnson	1,763,970	"	June	17, 1930
Johnson	2,067,533	"	Jan.	12, 1937

The rights of the plaintiffs in said patents, as aforesaid, have been as above stated throughout the period of alleged infringement of each of such patents prior to commencement of this suit.

5. By stipulation of the parties and on Motion of the plaintiff, the complaint of Outboard Marine and Manufacturing Company as to Irgens patent 1,802,652 was withdrawn from the trial of this Cause.

6. The first patent in suit is that of Johnson, No. 1,716,962, issued June 11, 1929 on an aplication filed August 25, 1926. Claims 11, 12, 13 and 14 are in issue.

(a) The court finds that claims 11 and 12 are not infringed because the motor of defendants' device is not mounted on the upper end of the drive shaft casing.

459 The disclosure of the patent shows a motor mounted on the upper end of the drive shaft casing. In the sense pointed out by counsel for plaintiff, defendants' motor is mounted on the upper end of the drive shaft

casing, but the disclosure of the patent shows a motor mounted on the upper end of the drive shaft casing in an altogether different way and in a way which defendants do not use.

(b) Claims 13 and 14 are infringed, if valid, by the two motors of defendants, the nine horse power motor and the sixteen horse power motor, and if the court is mistaken about the question as to whether or not defendants' motor is mounted on the upper end of the drive shaft casing, then claims 11 and 12 are infringed, if valid.

(c) The defendant cites against the Johnson patent No. 1,716,962 a number of patents, and particularly the following: Smith, 1,226,400; Echard (Fr.) 463,386; Stockemann, 1,131,287; Johnson, 1,559,616; Ducassou, 1,034,987; Saunders (Br.), 179,607 of 1921; Mandl (Ger.), 345,103; Lanchester (Br.), 14,792 of 1902; Pierce, 1,579,834; and Cowles, 1,234,293.

(d) In view of the patents cited, particularly Smith, 1,226,400 and Echard (Fr.), 463,386, the Johnson patent 1,716,962 discloses aggregation and the claims in issue are invalid.

(e) It is stated by counsel for plaintiff that some new result is brought about by the combination of the stream lined sides of the housing and the anti-cavitation plate. However, the stream lining does there what it is always intended to do, to permit a solid to pass through a liquid with the least possible friction and least resistance. The anti-cavitation plate is intended to act as a baffle to prevent air being pulled down by the passage of water through the propeller, and that is what the anti-cavitation plate does here. They both perform the functions which they have always performed and
460 in the same way. There is nothing new about what the two elements do here, and there is nothing new about the result which they bring about.

7. The next patent in suit is Johnson, 1,763,970, issued on an application filed June 18, 1928. Claims 3 and 14 are in issue.

(a) It is not contended that defendants' nine horse power motor infringes, but it is contended by the plaintiff that defendants' sixteen horse power motor does infringe both of these claims.

(b) Defendants' sixteen horse power motor casing

below the anti-cavitation plate is not bluntly rounded. No part of it is bluntly rounded. All of it has a knife-edge as that word is used in the art.

(c) Defendant cites against this patent the following patents: Echard (Fr.), 493,386; Ducassou, 1,034,987; Pierce, 1,579,834; Evinrude, 1,524,857; Grass, 1,639,339; Smith, 1,226,400; Lanchester (Br.), 14,792 of 1902; Saunders (Br.), 179,607 of 1921.

(d) Nobody prior to Johnson 1,763,970 showed the casing with stream lined contour having a knife edge in the front above an anti-cavitation plate cast in the housing and of stream lined contour below the anti-cavitation plate with bluntly rounded contour in front.

(e) Others have shown the use of stream lining with knife edge and with bluntly rounded contour, but the court cannot remember this particular combination. The court does not know what new results that combination gets.

(f) The court finds that claim 14 is anticipated and that it is pure aggregation. There may be some doubt about claim 3, but the best judgment and the find-
461 ing of the court is that claim 3 does not define an invention.

8. The next patent in suit is Pierce, Re. 18,118. Claim 19 is in issue.

(a) The court finds that the facts are such that both of the defendants' motors, the nine horse power motor and the sixteen horse power motor infringe this claim, if it is valid.

(b) Defendants' argument as to the invalidity of the reissue is sound.

(c) Against this patent the defendant cites Grass 1,639,339; Echard (Fr.), 463,386; Saunders (Br.), 179,607 of 1921; Lanchester (Br.), 14,792 of 1902 and Ducassou, 1,034,987.

(d) The court finds that in the Echard (Fr.) patent the propeller carrying member forms a rudder for steering. It is of stream line construction throughout its height. It does not extend above the water line, but if that is an advantage the court does not see why it did not occur to a mechanic who wanted to get more purchase on his rudder.

(e) The court finds that Grass No. 1,639,339 antici-

pates Pierce claim 19 and that the said Grass patent is a proper reference against this claim.

(f) The device shown in Saunders (Br.) patent is an outboard assembly wherein the propeller carrying member forms a rudder for steering and is of stream lined construction through its height. It does not extend above the water line, perhaps because it is fastened to the bottom of the boat.

(g) The court finds that Pierce Re 18,118 claim 19 reads on Lanchester (Br.) No. 14,792.

9. The next patent considered in argument was the Arndt patent No. 1,875,912 which was issued September 6, 1932 on an application filed January 30, 1928. Claim 16 is in issue.

462 (a) Claim 16 of this patent, it seems to the court, certainly descends to the minutiae of this art. The court believes it has a right to, and should, take that into account in determining how broadly this claim is to be construed.

(b) The Echard (Fr.) patent 463,386, is cited against Arndt and shows an opening on the front of the lower part of the casing something like a round hole that furnishes an intake for a pump. This opening is just about the same place in the casing as the opening in the Arndt patent, but the Arndt opening is of a different shape.

(c) Pierce patent 1,579,834 is also cited against this claim. It shows an intake in just about the place that the patent in suit discloses.

(d) The court finds that the facts indicate that this claim must be narrowly construed and that the court cannot go out of its way to find infringement. The court further finds that defendant does not have its inlet at the forward apex of the forwardly converging surfaces and considering claim 16 narrowly as the court believes it should, the defendant does not infringe.

10. The next patent in suit is Evinrude, 1,786,835, issued December 30, 1930 on an application filed October 20, 1928. Claims 1, 4, 5, 8, 9 and 10 are in issue.

(a) The court finds that the facts are such that if claims 1, 4, 8 and 9 are valid they would be infringed, and that claims 5 and 10 are not infringed.

(b) One element of claim 5 is "the vanes having wiping contact with the peripheral wall for a portion of its angular extent." Defendant does not have that.

(c) One element of claim 10 is "a water supply passage partitioned from said drive shaft in a forward portion
463 of said housing and leading to said chamber from a point therebeneath." The defendant does not have that.

(d) Against this patent defendant cites Pierce, 1,579,-834; Mandl (Ger.), 345,103; Ziegenspeck (Swiss), 58,818; Cowles, 1,234,293; Echard (Fr.), 463,386; Szekeley, 1,295,-234; Butler, 1,274,678; Applin, 1,366,149.

(e) The court finds that the Echard (Fr.), Mandl (Ger.), and Pierce patents are directly in point; and that Szekeley, Butler and Applin show the sort of pump which is disclosed by the Evinrude patent in suit.

(f) The court finds that the Evinrude patent, 1,786,835 in suit merely aggregates what was old in the art; and that the claims in suit are invalid.

11. The sixth patent in suit is Irgens, 1,869,749. Claims 1 and 2 are in issue.

(a) The defendant cites against this patent Perkins, 1,131,862; Miller, 1,073,920; Hardy, 1,169,030; Patch, 1,357,-079; Gray, 1,656,629; Stranahan, 1,697,794.

(b) The court finds that the facts are such as to indicate that anybody who was trying to do what Mr. Irgens was trying to do would get some ideas when he looked at Hardy, 1,169,030. Hardy has a truncated cone and shows several truncated cones in series.

(c) The court finds that it has doubt as to whether the claims of this patent in issue are definite enough, and the court further finds that Irgens patent 1,869,749 is not infringed.

12. Johnson patent No. 2,067,533 is the last patent in suit. Claims 1 and 2 are in issue.

(a) There are a number of patents cited against this Johnson patent, but the court finds that no citation is
464 necessary as there is no invention involved in or disclosed by that patent.

(b) The court finds that the facts are such that the defendant infringes the claims in issue of that patent, if they are valid, but that the patent in invalid.

Conclusions of Law.

1. Claims 11, 12, 13 and 14 of Johnson patent, No. 1,716,962 are invalid, being aggregations in view of patents to Smith, 1,226,400; Echard (Fr.), 463,386; Stockemann,

1,131,287; Johnson, 1,559,616; Ducassou, 1,034,987; Saunders (Br.), 179,607 of 1921; Mandl (Ger.), 345,103; Lanchester (Br.), 14,792 of 1902; Pierce, 1,579,834; and Cowles, 1,234,293, and particularly the Smith patent No. 1,226,400 and Echard (Fr.) patent 463,386.

2. Defendants' nine and sixteen horse power motors do not infringe claims 11 and 12 of said Johnson patent No. 1,716,962. If valid, claims 13 and 14 would be infringed by defendants' 9 and 16 horse power motors, but these claims are invalid.

3. There is no invention in casting an anti-cavitation plate integrally with the housing.

4. Claims 3 and 14 of Johnson patent No. 1,763,970 are invalid, being aggregations in view of the patent to Echard (Fr.), 493,386; Ducassou, 1,034,987; Pierce, 1,579,834; Evinrude, 1,624,857; Grass, 1,639,339; Smith, 1,226,400; Lanchester (Br.), 14,792 of 1902; Saunders (Br.), 179,607 of 1921.

5. Defendants' 16 horse power motor does not infringe the said claims 3 and 14 of patent No. 1,763,970.

6. Claim 19 of Pierce, Reissue patent No. 18,118 is invalid in view of patents to Echard (Fr.), 463,386; Grass, 1,639,339; Saunders (Br.), 179,607 of 1921; and Lanchester (Br.), 14,792 of 1902.

7. Defendants' 9 and 16 horse power motors would
465 infringe said claim 19 of Reissue patent 18,118, if it were valid, but said claim is invalid.

8. Claim 16 of Arndt patent No. 1,875,912 must be narrowly construed and as neither of defendants' 9 and 16 horse power motors has its inlet at the forward apex of the exterior surfaces, the defendant does not infringe said claim.

9. Claims 1, 4, 5, 8, 9 and 10 of Evinrude patent No. 1,786,835 are invalid being aggregations of devices old in the art, Echard (Fr.) 463,386; Mandl (Ger.), 345,103; and Pierce, 1,579,834 are direct in point. Szekely, 1,295,235; Butler, 1,274,678 and Applin, 136,649 show a sort of pump which is disclosed by this patent.

10. Claims 5 and 10 of Evinrude patent No. 1,786,835 are not infringed by defendants' 9 and 16 horse power motors. If valid, claims 1, 4, 8 and 9 would be infringed, but said claims are invalid.

11. Defendants' 9 and 16 horse power motors do not infringe the claims of the Irgens patent No. 1,869,749.

12. The Johnson patent No. 2,067,533 is invalid for want of invention. If valid, claims 1 and 2 of this patent would be infringed by defendants' device.

Barnes,
Judge.

Approved as to form:
Chas. W. Rummler,
Attorney for Defendants.
Geo. L. Wilkinson,
Attorney for Plaintiff.

Entered Feb. 20, 1940. 466 And afterwards, to wit, on the 20th day of February, A. D. 1940, being one of the days of the regular February term of said Court, in the record of proceedings thereof, in said entitled cause, before the Honorable John P. Barnes, District Judge, appears the following entry, to wit:

467 In the District Court of the United States

For the Northern District of Illinois,

Eastern Division.

Outboard, Marine & Manufacturing Company, a corporation of Delaware, *Plaintiff,* vs. Muncie Gear Works, Inc., a corporation of Indiana, and Bruns & Collins, Inc., a corporation of Illinois, *Defendants.*	Civil Docket No. 273.

FINAL DECREE.

This cause came on to be heard at this Term of this Court and upon consideration of the pleadings, the testimony of the witnesses for the respective parties in open court, the exhibits filed and offered in evidence by the respective parties and the statements and arguments of counsel for the respective parties in open court, it is

Ordered, Adjudged and Decreed as follows:

1. That claims 11, 12, 13 and 14 of Johnson patent No. 1,716,962 are invalid.

2. That claims 3 and 14 of Johnson patent No. 1,763,970 are invalid.

3. That claim 19 of Pierce Reissue patent No. 18,118 is invalid.

4. That claim 16 of the Arndt patent No. 1,875,912 as construed and limited, is not infringed by defendants' 9 and 16 horse power motors.

5. That claims 1, 4, 5, 8, 9 and 10 of the Evinrude patent No. 1,786,835 are invalid.

6. That the claims of the Irgens patent No. 1,869,749 are not infringed by the defendants' 9 and 16 horse power motors.

468 7. That Johnson patent No. 2,067,533 is invalid for want of invention.

8. As to Irgens patent in suit No. 1,802,652, the complaint is dismissed without prejudice on motion of the plaintiff and by stipulation of the parties.

9. That the Complaint herein be and the same is hereby dismissed.

10. That defendants recover from the plaintiff their costs and disbursements to be taxed.

Barnes,
Judge.

Chicago, Illinois,
February 20th, 1940.
Approved as to form:
Geo. L. Wilkinson,
Attorney for Plaintiffs.

472 And on, to wit, the 17th day of May, A. D. 1940, came the Plaintiffs-Appellants by their attorneys and filed in the Clerk's office of said Court their certain Notice of Appeal in words and figures following, to wit:

Filed May 17, 1940. 473 IN THE DISTRICT COURT OF THE UNITED STATES

For the Northern District of Illinois,

Eastern Division.

Outboard, Marine & Manufacturing Company, *et al.*, *Plaintiffs*, vs. Muncie Gear Works, Inc., and Bruns & Collins, Inc., *Defendants*.	Civil Docket No. 273.

NOTICE OF APPEAL.

Notice is hereby given that Outboard, Marine & Manufacturing Company and Johnson Brothers Engineering Corporation, plaintiffs in the above named and consolidated cause, hereby appeal to the Circuit Court of Appeals for the Seventh Circuit from the final decree entered in said consolidated cause on February 21, 1940, except that part thereof which decrees Pierce Re. patent No. 18,118 invalid.

S. L. Wheeler,
606 W. Wisconsin Av.,
Milwaukee, Wisconsin,
Geo. L. Wilkinson,
38 So. Dearborn St.,
Chicago, Ill.,
Attorneys for Plaintiffs-Appellants.

May 17th, 1940.

474 And on, to wit, the 27th day of May, A. D. 1940, came the Plaintiffs-Appellants by their attorneys and filed in the Clerk's office of said Court their certain Statement of Points in words and figures following, to wit:

475 IN THE DISTRICT COURT OF THE UNITED STATES. Filed May 27, 1940.

* * (Caption—273) * *

STATEMENT OF POINTS UPON WHICH APPELLANTS INTEND TO RELY ON THEIR APPEAL.

1. The District Court erred in not holding Claims 11 and 12 of Johnson patent No. 1,716,962 infringed by defendants' constructions.

2. The District Court erred in holdings claims in suit of Johnson patent No. 1,716,962 aggregative.

3. The District Court erred in failing to hold that in the construction of Johnson patent No. 1,716,962 the combined streamlined sides of the housing and the specific location of the anti-cavitation plate are patentably cooperative to produce a new result.

4. The District Court erred in not holding that the Johnson patent No. 1,716,962 covers a meritorious invention of great practical value, and that Claims 11, 12, 13 and 14 thereof are valid.

5. The District Court erred in not holding Claims 3 and 14 of Johnson patent No. 1,763,970 to be valid.

476 6. The District Court erred in holding Claims 14 of Johnson patent No. 1,763,970 to be anticipated and aggregative, and in holding Claim 3 not to define invention.

7. The District Court erred in not holding defendants' 16 horse power motor casing to be bluntly rounded below its anti-cavitation plate, and an infringement of Claims 3 and 14 of Johnson patent No. 1,763,970.

8. The District Court erred in holding that Claim 16 of Arndt patent No. 1,875,912 "descends to the minutiae of this art", and must be narrowly construed.

9. The District Court erred in failing to hold that defendants' outboard motors have their inlets at the forward apex of their forwardly converging surfaces in infringement of Claim 16 of Arndt patent No. 1,875,912.

10. The District Court erred in failing to find patent No. 1,786,835 valid as to Claims 1, 4, 5, 8, 9 and 10 in suit.

11. The District Court erred in holding Claims 1, 4, 5, 8, 9 and 10 of Evinrude patent No. 1,786,835 invalid as aggregations of features old in the art.

12. The District Court erred in failing to find Claim 5 of Evinrude patent No. 1,786,835 infringed as to vanes hav-

ing wiping contact with the peripheral wall of the pump chamber for a portion of its angular extent.

13. The District Court erred in not finding Claim 10 of Evinrude patent No. 1,786,835 infringed as to the water supply passage partitioned from the drive shaft in a forward portion of the housing and leading to the pump chamber from a point therebeneath.

14. The District Court erred in not finding Irgens patent No. 1,869,749 valid.

477 15. The District Court erred in not finding Irgens patent No. 1,869,749 infringed by defendants' outboard motors.

16. The District Court erred in finding that no invention is embodied in or disclosed by Johnson patent No. 2,067,533, regardless of the prior art patents, and that the said patent is invalid for want of invention.

17. The District Court erred in dismissing the bills of complaint in the above entitled consolidated cause, and in awarding costs to defendants (appellees).

18. The District Court erred in not entering a decree enjoining the defendants from further infringement of all of the patents in suit, except Pierce Re. 18,118, and each of them, and in awarding to plaintiffs (appellants) an accounting for profits and damages.

S. L. Wheeler,
606 W. Wisconsin Av.,
Milwaukee, Wis.,
Geo. L. Wilkinson,
38 So. Dearborn St.,
Chicago, Ill.,
Attorneys for Plaintiffs-Appellants.

Service of a copy of the foregoing Statement of Points acknowledged this 25th day of May, 1940.

Chas. W. Rummler,
Attorney for Defendants-Appellees.

469 And on, to wit, the 17th day of May, A. D. 1940, came the Plaintiff by its attorneys and filed in the Clerk's office of said Court its certain Appeal Bond in words and figures following, to wit:

470 APPEAL BOND. Filed May 1 1940.

Know All Men by These Presents:

That we, Outboard, Marine & Manufacturing Company, a corporation, as principal, and Fidelity and Deposit Company of Maryland, Baltimore, Maryland, as surety, are held and firmly bound unto Muncie Gear Works, Inc., a corporation, and Bruns & Collins, Inc., their attorneys, successors and assigns, in the full and just sum of Two Hundred and Fifty Dollars ($250.00), to be paid to the said Muncie Gear Works, Inc. and said Bruns & Collins, Inc., their attorneys, successors and assigns, to which payment well and truly to be made we bind ourselves, our successors and assigns, jointly and severally, firmly by these presents.

Sealed with our seals and dated this 13th day of May, in the year of our Lord One Thousand Nine Hundred and Forty.

Whereas, lately at a session of the District Court of the United States for the Northern District of Illinois, in a suit pending in said Court between Outboard, Marine & Manufacturing Company and Johnson Brothers Engineering Corporation, plaintiffs, and Muncie Gear Works, Inc. and Bruns & Collins, Inc., defendants, a decree was rendered against said Outboard, Marine & Manufacturing Company and said Johnson Brothers Engineering Corporation, and said Outboard, Marine & Manufacturing Company and said Johnson Brothers Engineering Corporation have filed a notice of appeal from said decree to the United States Circuit Court of Appeals for the Seventh Circuit;

Now, the condition of the above obligation is such that if the said Outboard, Marine & Manufacturing Company and said Johnson Brothers Engineering Corporation shall prosecute their said appeal to effect, and shall answer
471 all costs that may be awarded against them, if said
appeal is dismissed or said decree affirmed, or for such costs as the appellate court may award if the said decree is modified, then the above obligation to be void; otherwise to remain in full force and virtue.

Outboard, Marine & Manufacturing Company,
(Seal) By J. Stern.

Fidelity and Deposit Company of Maryland,
By Stanley T. Webb,
(Seal) *Attorney-in-Fact.*

652 And on, to wit, the 27th day of May, A. D. 1940, there was filed in the Clerk's office of said Court a certain Stipulation of Record on Appeal in words and figures following, to wit:

653 IN THE DISTRICT COURT OF THE UNITED STATES.

* * (Caption—273) * *

STIPULATION OF RECORD ON APPEAL.

To the Clerk of the United States District Court:

It is hereby stipulated and agreed by and between the parties hereto that for the purposes of the appeal heretofore taken in the above-entitled cause to the United States Circuit Court of Appeals for the Seventh Circuit, the clerk is requested to make up and forward to the said Circuit Court of Appeals a Transcript of Record, and include in said transcript only the following pleadings, papers, documents, testimony and exhibits:

1. Complaint in Civil Docket No. 273, filed herein on January 19, 1939.
2. Complaint in Civil Docket No. 274, filed herein on January 19, 1939.
3. Answer to complaint in Civil Docket No. 273, filed February 17, 1939.
4. Answer to complaint in Civil Docket No. 274, filed February 17, 1939.
5. Stipulation entitled in Civil Dockets Nos. 273 and 274, December 28, 1939.

654 6. Court Order, January 30, 1940, consolidating cause No. 274 with cause No. 273.

7. Reporter's typewritten stenographic transcript of proceedings and testimony in open court, with portions thereof deleted as indicated on copy thereof filed herewith.
8. Excerpt from closing argument of counsel for plaintiff.
9. Opinion of trial court of February 1, 1940.
10. Findings of fact and conclusions of law, February 21, 1940.
11. Final decree, February 21, 1940.
12. Appeal bond.
13. Notice of appeal.

14. This stipulated designation of contents of record on appeal.

15. Statement of points on which appellants intend to rely on appeal.

16. Documentary exhibits offered and received in evidence as follows:

Plaintiffs' Documentary Exhibits.

Nos. 5 to 9 inc.—Drawings stipulated to represent accused constructions. (See Stipulation—Item 5.)

No. 10—Johnson patent No. 1,716,962, June 11, 1929.

No. 11—Johnson patent No. 1,763,970, June 17, 1930.

No. 12—Pierce Re. patent No. 18,118, July 7, 1931.

No. 13—Evinrude patent No. 1,786,835, December 30, 1930.

No. 14—Irgens patent No. 1,869,749, August 2, 1930.

No. 15—Arndt patent No. 1,875,912, September 6, 1932.

No. 16—Johnson patent No. 2,067,533, June 12, 1936.

655 No. 21—Tabulated list of sales of motors having streamlined feature.

No. 30—Drawings of defendants' spark plug cover.

Defendants' Documentary Exhibits.

The following prior art patents:

U. S. Patents.

Thorsen	No. 871,459
Ducassou	1,034,987
Miller	1,073,920
Stockemann	1,131,287
Perkins	1,131,862
Hult	1,146,427
Hardy	1,169,030
Smith	1,226,400
Cowles	1,234,293
Butler	1,274,678
Szekeley	1,295,234
Patch	1,357,079
Tripp	1,359,291
Applin	1,366,149
Johnson	1,467,641

Asbury	1,511,867
Evinrude	1,524,857
Johnson	1,559,616
Evinrude	1,567,127
Pierce	1,579,834
Grass	1,639,339
Gray	1,656,629
Stranahan	1,697,794
Rice	1,733,361
Rebezzana	1,806,548

British Patents.

Lanchester	14,792
Nydegger	16,121
Saunders	179,607

German Patent.

Mandl	345,103

French Patent.

Echard	463,386

Swiss Patent.

Ziegenspeck	58,818

The following publications:

"A Treatise on Hydraulics", pages 317-318, by Mansfield Merriman—Pub. 1896 by John Wiley & Sons, N. Y.

656 "The Speed and Power of Ships", by D. W. Taylor, Vol. 1, pages 124-125; Vol. II, Figs. 3 to 20, pub. 1910 by John Wiley & Sons, Inc., N. Y., N. Y.

"Text-Book of Theoretical Naval Architecture", by Edward L. Atwood, pages 250-256, pub. Jan. 1919 by Longsman, Green & Co., London, England.

Graybar Electric Co., Catalog #100, Pub. 1929 by Graybar Electric Co., pages 402, 414, 417 and 650.

S—Defendant's working drawing showing clearances maintained between the pump impeller and the pump housing both at its top and its periphery.

Plaintiff's Physical Exhibits.

Nos. 1 to 5—Defendants' literature containing illustrations of products manufactured, sold and used by the defendants.

No. 5A—Enlarged chart of Plaintiffs' Exhibit No. 5.

No. 8A—Enlarged chart of Plaintiffs' Exhibit No. 8.

No. 9A—Enlarged chart of Plaintiffs' Exhibit No. 9.

No. 17—Specimen of defendants' 9 horse power "Neptune Twin".

No. 18—Specimen of defendants' larger outboard motor product known as "Neptune Master".

No. 19—Blueprint L-5 made by Harry Johnson, showing streamline section housing, dated May 23, 1924.

No. 20—Beebe drawing dated December 21, 1927.

No. 22—Evinrude 1929 catalog.

No. 23—Evinrude 1930 catalog.

No. 24—Evinrude 1931 catalog.

No. 25—Reproduction of drawings of Johnson patent No. 1,716,962.

No. 26—Enlarged chart of drawings of Johnson patent No. 1,763,970.

No. 27—Enlarged chart of drawing of Evinrude patent No. 1,786,835.

No. 28—Enlarged chart of drawing of Arndt patent No. 1,875,912.

657 No. 29—Elto "Speedy Twin" outboard motor.

Defendants' Physical Exhibits.

A—Book of prior art patents and publications.

B—Stem or lower unit for Elto motor.

C—Stem or upper housing for 9-horse power motor built by defendant, including mounting bearing, drive shaft and impeller.

D—Skeg or lower housing for defendants' 9-horse power motor.

E—Skeg or lower gear housing of 16-horse power motor shown on Print OV-1690 of Muncie Gear Works.

F—Upper housing member of defendants' 16-horse power motor.

G—Muffler or exhaust tube for defendants' 16-horse power motor.

H—Motor head for the 9-horse power motor manufac-

tured by defendant, showing spark plug cover used by defendant.

I—Certified copy of file wrapper and contents of plaintiff's patent No. 1,716,962, Johnson.

J—Certified copy of file wrapper and contents of plaintiff's patent No. 1,763,970, Johnson.

K—Certified copy of file wrapper and contents of plaintiff's patent No. 1,786,835, Evinrude.

M—Certified copy of file wrapper and contents of plaintiff's patent No. 1,869,749, Irgens.

N—Certified copy of file wrapper and contents of plaintiff's patent No. 1,875,912, Arndt.

O—Defendant's working drawing for lower stem adapter.

P—Defendant's working drawing of gear housing.

Q—Defendant's working drawing showing lower stem adapter for 16-horse power motor.

658 R—Defendant's working drawing showing gear housing for defendant's 16 horse power motor.

Dated this 25th day of May, 1940.

S. L. Wheeler,
Geo. L. Wilkinson,
Attorneys for Plaintiffs.
Chas. W. Rummler,
Attorney for Defendants.

659 And on, to wit, the 25th day of June, A. D. 1940, there was filed in the Clerk's office of said Court a certain Stipulation in words and figures following, to wit:

660 IN THE DISTRICT COURT OF THE UNITED STATES. Filed June 25, 1940.

* * (Caption—273) * *

STIPULATION.

It Is Stipulated and Agreed By and between the parties to the above-named consolidated cause, that the time for filing the record on appeal and docketing the consolidated action is extended to and including July 16, 1940.

Geo. L. Wilkinson,
S. L. Wheeler,
Attorneys for Plaintiffs-Appellants.
Chas. W. Rummler,
Attorney for Defendants-Appellees.

June 24th, 1940.

It Is So Ordered:

Barnes,
United States District Judge.

661 And on, to wit, the 25th day of June, A. D. 1940, there was filed in the Clerk's office of said Court a certain Stipulation in words and figures following, to wit: Filed June 25, 1940.

662 IN THE DISTRICT COURT OF THE UNITED STATES.

* * (Caption—273) * *

STIPULATION.

It Is Stipulated and Agreed By and between the parties hereto, that both the Plaintiffs' and Defendants' original documentary exhibits in the above entitled cause and also in Civil Action No. 274, be included in and made a part of the transcript of the record in this cause, to be transmitted to the Court of Appeals.

Geo. L. Wilkinson,
S. L. Wheeler,
Attorneys for Plaintiffs.
Chas. W. Rummler,
Attorney for Defendants.

June 24th, 1940.

Approved:

Barnes,
United States District Judge.

312

Dec. 30, 1930. O. EVINRUDE 1,786,835

WATER COOLING SYSTEM FOR OUTBOARD MOTORS

Filed Oct. 20, 1928 2 Sheets-Sheet 1

Fig. 1.

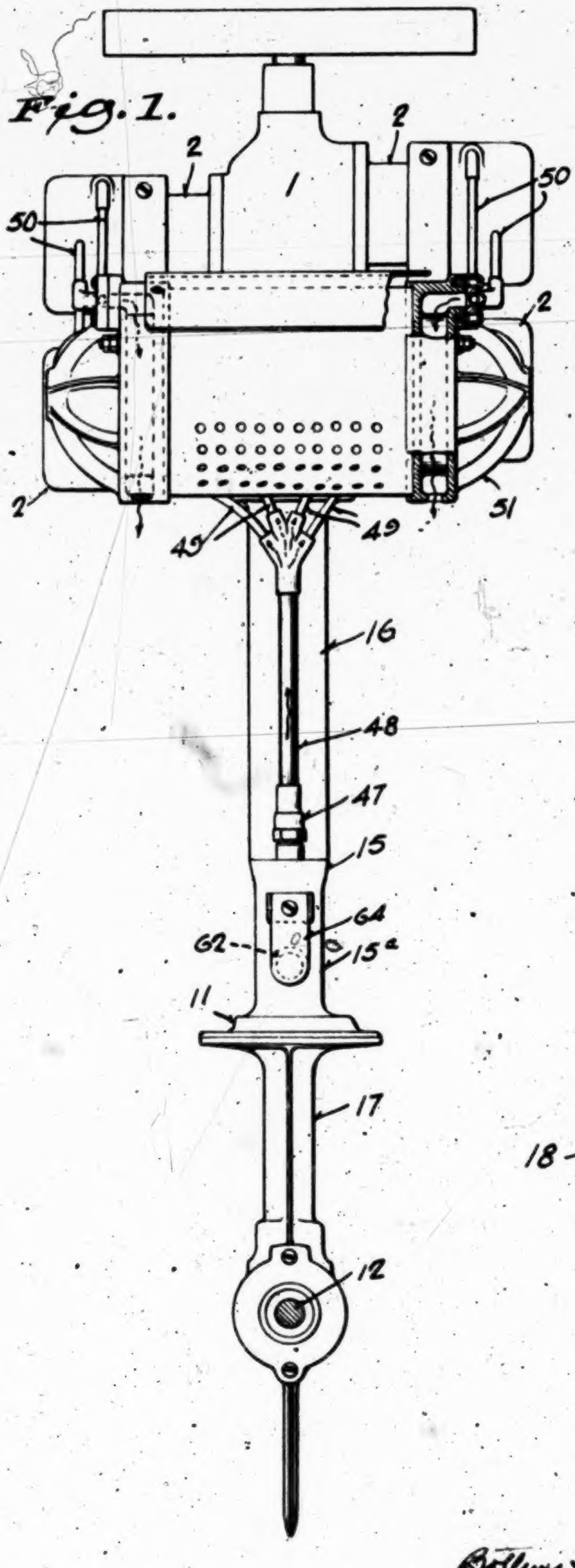


Fig. 2.

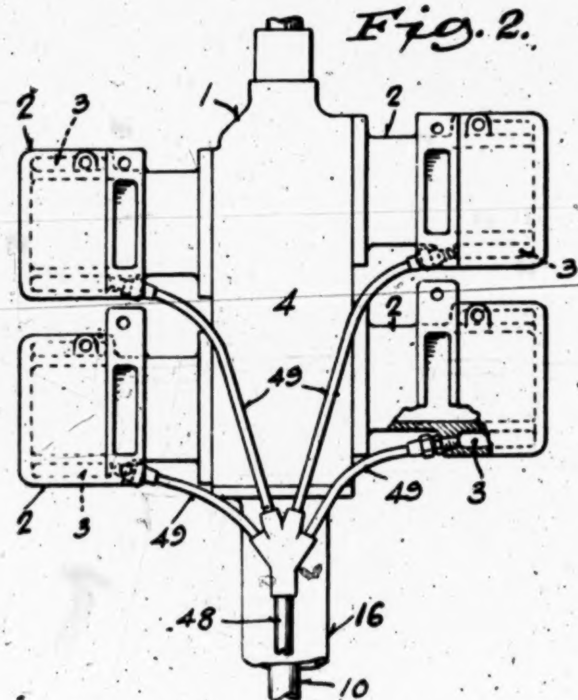
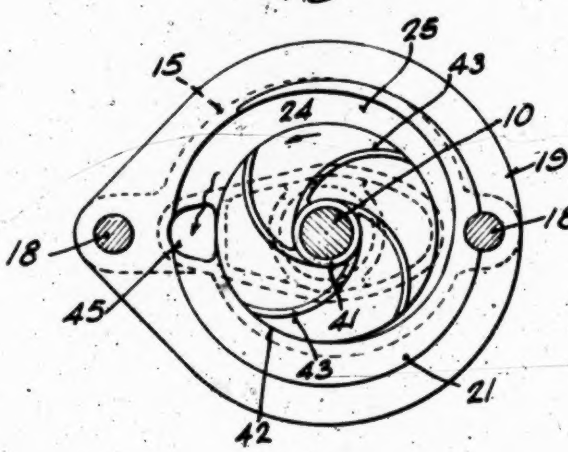


Fig. 6.



INVENTOR.
OLE EVINRUDE

BY

Bottum, Hudnall, Lecher, McNamara and Michael
ATTORNEYS.

Dec. 30, 1930. O. EVINRUDE 1,786,835

WATER COOLING SYSTEM FOR OUTBOARD MOTORS

Filed Oct. 20, 1928 2 Sheets-Sheet 2

Fig. 3.

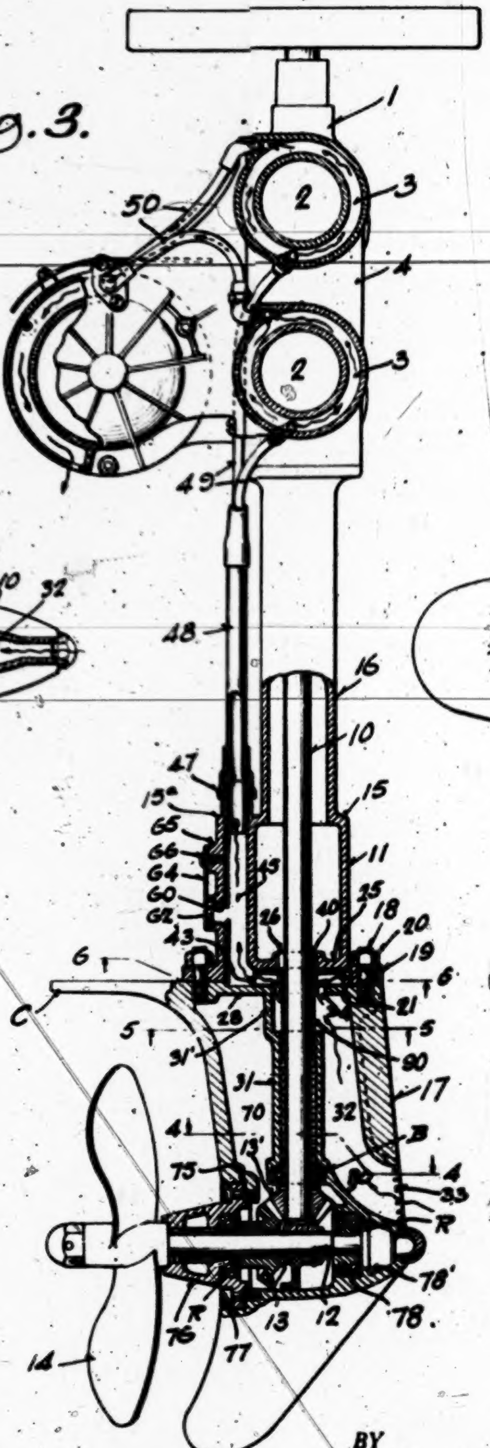


Fig. 4.

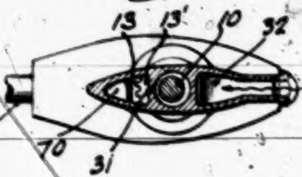


Fig. 5.

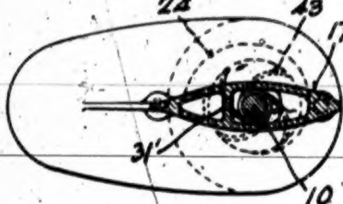


Fig. 7.

INVENTOR.
OLE EVINRUDE

BY

Bottum, Hudnall, Lecher, McNamara and Michael

ATTORNEYS.

Patented Dec. 30, 1930

1,786,835

UNITED STATES PATENT OFFICE

OLE EVINRUDE, OF MILWAUKEE, WISCONSIN, ASSIGNOR, BY MESNE ASSIGNMENTS, TO OUTBOARD MOTORS CORPORATION, A CORPORATION OF MICHIGAN

WATER-COOLING SYSTEM FOR OUTBOARD MOTORS

Application filed October 20, 1928. Serial No. 313,737.

This invention relates in general to outboard motors and more particularly to a water cooling system especially designed and adapted for organization with such motors.

The problem of cooling an outboard motor is a long standing one in this art and in an effort to solve it various expedients have been resorted to. For instance, it has been proposed to drive plunger pumps from the motor but this expedient has not proven satisfactory for a number of reasons. In the first place the pump of the plunger type lacks the capacity to satisfactorily serve the requirements of an outboard motor when the pump is built of a size appropriate to the general design and plan of construction of such a motor. Further, it is difficult to construct a plunger pump that will stand up under the usage met in outboard motors. The plunger must be a fluid tight fit in its barrel and this cannot be maintained as both plunger and barrel become badly scored in use due to the presence of sand and the like in the water being handled.

Another expedient that has been resorted to is the organization of a propeller pump with motors of this type. Propeller pumps are not as positive as are necessary. In an outboard motor the water cooling system necessarily utilizes very small pipes and corrosion and obstructions resulting from the presence of sand, mud, leaves, grass, etc., in the water will reduce the volume of flow of the cooling medium or prevent it when the propeller is relied upon to impel the water through the system. Further, any variation in the propeller speeds effects a corresponding variation in the flow of the propelling medium and a great reduction in such flow occurs when the motor is slowed down.

One of the principal objects of the present invention resides in the provision of a water cooling system for an outboard motor of such a character as to be susceptible of convenient incorporation into the construction of the motor and as to be capable of developing ample and adequate flow of the cooling medium through the system under all circumstances. The circulation of the water through the cooling system is entirely positive and at all engine speeds the water is circulated in sufficient volume to satisfy the requirements of the motor and prevent dangerous and injurious overheating. To prevent the development of excessive pressures in the water cooling system the present invention proposes for the automatic relief of the pressure when it exceeds a predetermined amount.

Another object of the invention is to provide a water cooling system of this character having a pump so constituted that its effectiveness will not be impaired by the action of sand, grit, or the like.

A further object of the invention resides in the provision of a pump of this character which does not appreciably or materially cut down the power output of the motor although utilizing the motor as the source of its positive actuation.

Another object of the invention resides in the provision of a water cooling system which not only cools the cylinders of the motor but which also prevents excessive overheating of the muffler.

Another object of the invention is to provide an outboard motor having a water cooling system of the character mentioned incorporated in the structure in such manner that the pump and other elements of the water cooling system are, for the most part, entirely housed and protected and yet are readily accessible for purposes of adjustment, replacement or repair, should such become necessary.

Still another object of the invention resides in the provision of a water cooling system of an outboard motor which is simple and durable in construction, reliable and effective in operation and easy and comparatively inexpensive to manufacture.

Other objects and advantages reside in certain novel features of the construction, arrangement and combination of parts, which will be hereinafter more fully described and particularly pointed out in the appended claims, reference being had to the accompanying drawings forming a part of this specification, and in which:

Figure 1 is a view partly in rear elevation and partly in section and illustrating an out-

board motor equipped with a water cooling system embodying the present invention;

Figure 2 is a fragmentary view in elevation of part of the motor shown in Figure 1, the muffler being removed and parts being shown in section for the sake of illustration;

Figure 3 is a view partly in central vertical longitudinal section and partly in side elevation further illustrating the water cooling system of the motor shown in Figure 1;

Figures 4, 5 and 6 are views in horizontal section taken on lines 4—4, 5—5 and 6—6, respectively, of Figure 3; and

Figure 7 is a fragmentary view in front elevation showing the construction of the lower portion of the motor and illustrating the inlet to the pump thereof.

Referring to the drawings wherein for the sake of illustration is shown one embodiment of the invention, the numeral 1 designates generally an outboard motor which has its cylinders 2 provided with water jackets 3. The cylinders of which four are shown are secured to the opposite sides of a crank case 4 in accordance with the standard practice. The crank shaft of the engine is not shown but in the type of motor illustrated it is constructed, mounted and driven as illustrated in the co-pending application of Ole Evinrude for four cylinder outboard motors, filed February 27, 1928, Serial Number 257,501, to which application reference is made for a full disclosure of these features.

For the purposes of the present invention, it is sufficient to understand that the engine has its crank shaft coupled to a drive shaft 10 which extends downwardly through a sectional housing designated generally at 11, the drive shaft 10 being geared to a propeller shaft 12 by intermeshing beveled gears 13 and 13′. The rearward end of the propeller shaft 12 projects exteriorly of the housing and has a propeller 14 mounted thereon and suitably connected thereto.

The housing 11 includes an upper tubular section 15 having a bearing sleeve portion 16 adapted to be rotatably fitted in a bearing bracket clamped or otherwise secured to the stern of the boat in accordance with the usual practice. The sectional housing 11 is completed by a lower housing section 17 of the approximate stream-line section shown in the drawings and the two sections are held in assembly by stud bolts 18 threaded into the flanged upper end 19ᵃ of the lower housing section 17 and extending through an outwardly directed annular flange 19 formed at the lower end of the upper housing section 15, nuts 20 being threaded on the stud bolts and bearing against the flange to secure the parts assembled. Any suitable fastening device may be employed in lieu of the stud bolts 18 and nuts 20. A gasket or other suitable packing may be provided between the sections of the housing.

A centrifugal pump is incorporated in the housing 11 and the chamber 24 of this pump is defined by coacting structure of the housing sections. Thus, as shown in Figures 3 and 6 the upper section 11 has a transverse wall 25 adjacent its lower end. The transverse wall, although set up within the lower end of the housing section 15 slightly, completely closes the lower end of the upper housing section 15 proper, except for a flanged central opening 26 provided in the wall and through which the drive shaft 10 loosely extends. The structure of the pump chamber also includes a transverse or horizontal wall 28 integral with the lower housing section and just slightly spaced from the upper end of the lower section.

The upper housing section 15 has an integral downwardly directed rib or flange 21 which interfits with the lower section in the assembly for the purpose of alining the sections and also for defining the contour of the periphery of the pump chamber. As clearly shown in Figure 6, the flange 21 extends spirally about the axis of the shaft 10 and extends from one side of the outlet from the pump chamber to a point slightly spaced from the opposite side of such outlet. The flange 19 is of gradually increasing or tapering thickness from one end to the other.

The lower housing section is formed with the inlet to the pump chamber and preferably this inlet is defined by means of a wall 30 cast integral with the wall 28, with the lower section 17 of the housing and with a bearing sleeve 31 through which the drive shaft 10 extends. The inlet passage thus defined is designated at 32 and communicates with the pump chamber 24 through an opening 34 provided at the center of the wall 28. At its lower end the inlet passage 32 has a screen intake opening 33 positioned in the forward portion of the lower section of the housing whereby the inlet passage acts as a scoop to feed the water to the pump chamber and to aid in the circulation of the water through the system when the boat is running ahead. As shown, the wall 30 extends between opposed walls of the lower housing section 17 and inwardly and upwardly from the intake opening 33 until it merges into the sleeve 31 and above the sleeve 31 the wall is offset inwardly with respect to the lower portion thereof and to the sleeve 31 as indicated at 31′ so that the inlet passage 32 has free and unobstructed communication with the center of the pump chamber through the opening 34. In other words, the pump is provided with an axial inlet and the inlet means is of such character that a force feed is had to the pump chamber.

An impeller, designated generally at 40, is positioned in the pump chamber 24 and is

fixed to the drive shaft 10. Preferably this impeller has a hub 41 keyed to the drive shaft 10 and has a plate-like or web-like body 22 in the form of a disc abutting flatly up against the upper wall 25 of the pump chamber and with the drive shaft 10 closing the opening 26 in the wall 25. Cast integral with the plate-like body and with the hub of the impeller are a number of blades or vanes 43 which curve outwardly from the hub and rearwardly with respect to the direction of rotation of the impeller. As shown in Figure 6, the impeller, although mounted on the drive shaft and thus concentric with the housing proper, is somewhat eccentric with respect to the inner peripheral wall of the pump chamber 24 since this wall of the pump chamber is defined by the flange 21 which is eccentric or spirally curved with respect to the axis of the shaft 10.

The pump chamber communicates at one point in its periphery with a discharge passage 45 formed in a rearward enlargement or extention 15^a integral with the upper section 15 of the housing 11.

The impeller vanes 43 wipe against the peripheral wall of the pump chamber for a small portion only of its angular extent, as will be understood from ~~Figure 6~~. Past the zone of contact of the vanes 43 and the peripheral wall of the pump chamber, the peripheral wall curves gradually away from the path of the blades to provide a space enlarging toward the outlet and into which the impeller throws the water.

The discharge passage is connected by means of a coupling 47 with a pipe 48 having branches 49 leading into the water jackets 3 of the cylinder. After circulating through the water jackets 3, the water passes through short pipes 50 to the water spaces or water jackets 51 formed in the heads 52 of the muffler designated generally at 53. Thus, the water, after cooling the cylinders of the engine, further cools the heads of the mufflers and tends to prevent the mufflers from becoming too highly heated. In addition to their water jackets, the mufflers are formed with fins 55 also operating to radiate and dissipate the heat.

With this construction, when the engine is running and when the lower end of the housing is submerged in the water as it always is when the motor is in operative position on the boat, the impeller 40 partakes of the rotation of the drive shaft 10 and forces the water from the pump chamber into the discharge passage with a centrifugal action and consequently also draws water into the pump chamber through the inlet passage 32. The water passes into the spaces between the vanes 43 adjacent the hub 41 and is thrown outwardly by the rotating vanes and around to the outlet 45. When the boat is moving forwardly the feed of the water to the pump chamber results not only from the action of the impeller but also from the scoop-like action of the inlet 33 which picks up the water as the boat advances and displaces it up through the inlet passage 32 into the pump chamber.

As the speed of the motor and boat increases the force with which the scoop inlet feeds the water to the pump chamber correspondingly increases and the inrushing water acts on the vanes 43 in a manner tending to rotate the impeller and drive shaft thereby compensating for any fraction of the power output of the motor that would otherwise be required to drive the pump. With a comparatively small size impeller a high degree of pressure is developed and a very efficient pumping action is had so that the water will be positively circulated and the system will be maintained clear of obstructions that, in the absence of positive circulation, might build up in the system as a result of corrosion or as a result of the deposit in the system of some of the suspended matter in the water. And sand, grit, or the like, even if it scores the vanes of the impeller or the walls of the pump chamber, will not impair the efficiency of the pump inasmuch as the vanes will remain effective to throw the water outwardly and around toward the outlet. While it is desirable to have the vanes have wiping contact with the peripheral wall of the pump chamber just past the outlet, this contact need not be so liquid tight as the plunger in the barrel of a reciprocating pump. In fact, the pump disclosed is so efficient and develops such a positive circulation that there may be some possibility of excessive pressures developing in the system at times and to prevent the pressure from building up above the desirable and proper amount the discharge passage may, if desired, be provided with a vent or relief port 60 normally closed by a safety valve 62 which may consist of a disc 63 carried by a blade spring 64 of proper strength, one end of the blade spring being fixed to the disc valve and the other end being fixed by means of a screw 66 to a seat 65 provided on the upper housing section 11. The strength of the spring is such as to maintain the safety valve closed until the pressure in the discharge passage exceeds a predetermined or desirable point whereupon the pressure automatically opens the valve against the action of its spring. As soon as excessive pressure is relieved the valve automatically closes.

It will be noted that the wall 30 which defines the inlet passage also defines a gear housing or gear chamber 70 which is completely enclosed and which houses and protects the beveled gearing and the bearings for the propeller shaft as well as the lower bearing for the drive shaft. To permit of

convenient assembly of these parts, the lower housing section has an opening in its rear wall and around the opening is formed with a flanged seat 75. A combined closure and bearing carrier 76 has one end interfitted with the seat and secured thereto by stud bolts 77. By removing the stud bolts 77 and pulling out the combined closure and bearing carrier 76 the entire propeller shaft assembly may be removed as the beveled gear 13 and the roller bearing assemblies R and R' for the propeller shaft are mounted on the propeller shaft. In the assembly the inner bearing R' for the propeller shaft is received in a flanged bearing seat 78 formed in the housing. The flange 78' of this seat limits the inward movement of the inner propeller and, of course, the outward movement of this bearing assembly and of the other elements on the propeller shaft is prevented by the action of the combined carrier and closure 76 and the stud bolts 77.

The portion of the drive shaft 10 just above the sleeve gearing 31 and lying in the path of the incoming water may be protected by a bushing 90. If desirable, suitable packing may be employed between the sleeve 30 and the shaft 10. At the lower end of the sleeve 30 a roller bearing B is provided for the shaft 10. The lower section of the housing may have a cavitation plate C integral therewith.

The pump chamber may be built in the housing well above the water line and so may be made of any size without increasing the resistance to the forward motion of the boat. Further, the impeller is driven from the drive shaft and at drive shaft speed, a very desirable feature over a propeller shaft drive inasmuch as the propeller shaft is usually geared down. The character of the inlet is one of the features that makes this novel and advantageous organization possible.

Obviously, various changes in the size, shape and arrangement of parts may be made without departing from the spirit and substance of the invention and the scope of the appended claims. In particular the shape of the vanes and the construction and form of the pump chamber may be varied. Thus straight radial vanes, in lieu of curved vanes, may be employed and the impeller may operate in pump chambers of various shapes.

The invention claimed is:

1. In combination with an outboard motor having jacketed cylinders, a drive shaft actuated from the motor, a propeller shaft geared to the drive shaft and having a propeller fixed thereto, a housing for the drive and propeller shafts and the gearing, said housing including sections having coacting means defining a pump chamber, an impeller in said chamber actuated from the drive shaft, the lower section of the housing having an inlet to the pump chamber opening forwardly at a point adjacent the propeller shaft whereby to be well submerged, the other section having an outlet leading therefrom, and means connecting the pump outlet with the jackets of the cylinder.

2. In combination, an outboard motor having a water cooling system, a propeller, driving means for the propeller actuated from the motor, a housing for the driving means including sections having coacting structure defining a pump chamber, an impeller operating in said pump and actuated from the driving means, one of the sections of the housing having an inlet passage leading into the pump chamber, the other section of the housing having a discharge passage communicating with the pump chamber and connected to the water cooling system, said discharge passage having a relief port and a safety valve coacting with the relief port.

3. In combination, an outboard motor having a water cooling system, a propeller, driving means for the propeller actuated by the motor, a housing for the driving means, a centrifugal pump in said housing and actuated from the driving means, a connection between the pump and the water cooling system, and means for automatically relieving the system of the cooling medium when the pressure exceeds a predetermined point.

4. In combination, an outboard motor having a water cooling system, a propeller, driving means for the propeller, a housing for the driving means made up of a pair of sections having coacting structure defining a pump chamber, an impeller operating in the pump chamber and actuated from the driving means, the lower section of a housing having an intake opening and having an internal wall defining an inlet passage leading from the intake opening to the pump chamber and also defining a separate gear chamber for elements in the driving means, and a connection between the discharge of the pump and the water cooling system.

5. In combination, an outboard motor having a water cooling system, a drive shaft actuated from the motor, a propeller geared to the drive shaft, a housing for the drive shaft, said housing having spaced transverse walls defining a pump chamber, said walls having openings through which the drive shaft loosely passes, the peripheral wall of the chamber being eccentrically or spirally curved, an impeller operating the said pump chamber and including a hub fixed to said drive shaft, a plate-like body fixedly connected to the hub and bearing against one wall to close the opening thereof, and vanes fixed to rotate with the hub and body and located on one side of the body, the housing having an inlet communicating with the unobstructed opening of the pump chamber, and discharge

means communicating with a peripheral portion of the pump chamber, the vanes having wiping contact with the peripheral wall for a portion of its angular extent.

6. In combination, an outboard motor having a water cooling system, a drive shaft actuated from the motor, a propeller geared to the drive shaft, a housing for the drive shaft, said housing having spaced transverse walls defining a pump chamber, said walls having openings through which the drive shaft loosely passes, an impeller operating in said pump chamber and including a hub fixed to said drive shaft, a plate-like body fixedly connected to the hub and bearing against one wall to close the opening thereof, and vanes fixed to rotate with the hub and body and located on one side of the body, the housing having an inlet communicating with the unobstructed opening of the pump chamber, and discharge means communicating with a peripheral portion of the pump chamber.

7. In combination, an outboard motor, a water cooling system therefor, a drive shaft actuated from the motor, a propeller shaft, a propeller fixed to the propeller shaft, intermeshing gears, one on each of said shafts, bearing assemblies mounted on the propeller shaft, a supporting and enclosing housing for the said shafts and gearing having an opening permitting of the assembly of the propeller shaft and of the elements carried thereby as a unit, and a closure mounted on the propeller shaft and adapted to be interfitted with the opening and secured to the housing to maintain the assembly, a pump actuated from the drive shaft located in said housing and connected with the water cooling system, and means within the housing defining an inlet to said pump and a separate gear chamber for the propeller shaft gears and bearings.

8. In an outboard motor having an engine, a propeller and an upright drive shaft operatively connected with said engine and said propeller, of a shaft housing of substantially stream lined contour in horizontal cross section in its submersible portion, the shaft being disposed in the widest part of said housing and the walls of said housing being extended convergingly at the rear of the shaft, of a water circulation system including a pump chamber in the wider portion of said housing at an intermediate point therein, a water passage formed in said housing below said chamber and leading centrally thereto from an inlet disposed materially therebeneath, and a delivery passage formed above said chamber between the rearwardly converging walls of said housing, together with a centrifugal pump runner mounted on said shaft within said chamber.

9. In an outboard motor structure, a lower unit comprising a sectional shaft housing having an anti-cavitation plate adjacent which the shaft housing sections are secured together, the abutting ends of said sections being formed to provide a pump chamber constituting an enlargement of said plate, a pump in said chamber operatively connected for operation from said drive shaft, an inlet passage leading to said chamber from below said plate, and a delivery passage leading upwardly from said chamber above said plate.

10. In an outboard motor, a lower unit comprising an upright drive shaft and a housing therefor of approximately stream lined contours in horizontal section, the submersible portion of said housing being provided with an anti-cavitation plate centrally thickened in a vertical direction and having internally a pump chamber, pumping means disposed in said chamber and operatively connected with said drive shaft, a water supply passage partitioned from said drive shaft in a forward portion of said housing and leading to said chamber from a point therebeneath, and a delivery water passage partitioned from said shaft in a rearward portion of said housing and leading upwardly from said chamber.

11. In an outboard motor structure, a lower unit comprising an upright drive shaft carrying a pump runner intermediate its ends, a housing enclosing said shaft, a partition within said housing terminating below said runner and providing a water passage having an opening to the exterior of said housing and leading centrally to said runner, said partition being formed to enclose said shaft to a point adjacent said runner, a bushing extension of said partition encircling said shaft and embodying the lower face of said runner, and partition means above said runner defining a delivery passage spaced wholly at one side of said shaft for the delivery of water upwardly from said runner, whereby water and grit are excluded from contacting said shaft.

12. In an outboard motor, the combination with a drive shaft and cylinders respectively disposed at opposite sides of said drive shaft and provided with jackets, of spaced muffler heads independently jacketed and disposed adjacent the respective cylinders in operative connection therewith, the interior portions of the respective heads being adapted to receive gases from the interiors of the respective cylinders, and the jackets of the respective heads being independently connected to the jackets of the respective cylinders to which the heads are adjacent.

13. In an outboard motor structure, the combination with a drive shaft and cylinders disposed at opposite sides thereof, of a muffler mounted approximately parallel to the cylinders and provided with heads operatively connected to receive exhaust gases from respective cylinders, a muffler structure provided with an exhaust outlet disposed be-

tween said heads, independent jackets for said heads, and a cooling system for said engine including connections to the jackets of the muffler heads.

14. In an outboard motor structure, the combination with a plurality of cylinders, of a muffler having its ends connected with different cylinders and provided with an outlet for exhaust gases from the cylinders to which the ends of the muffler are connected, independent water jackets on the ends of said muffler, and a water supply passage branched to provide individual connections to the respective jackets.

15. In an outboard motor structure, the combination with a plurality of cylinders, of a muffler having its ends connected with different cylinders and provided with an outlet for exhaust gases from the cylinders to which the ends of the muffler are connected, independent water jackets on the ends of said muffler, and a water supply passage branched to provide individual connections to the respective jackets, said cylinders being provided with jackets respectively communicating with the jackets on the muffler portions receiving exhaust gases therefrom.

In witness whereof, I hereto affix my signature.

OLE EVINRUDE.

322.

July 7, 1931. J. H. PIERCE Re. 18,118

MARINE PROPULSION DEVICE

Original Filed Oct. 10, 1924

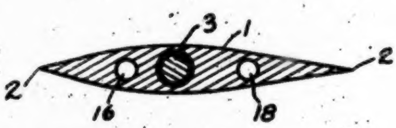


Fig-2-

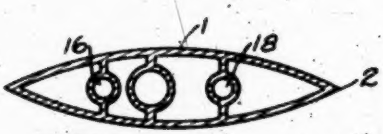


Fig-4-

Fig-3-

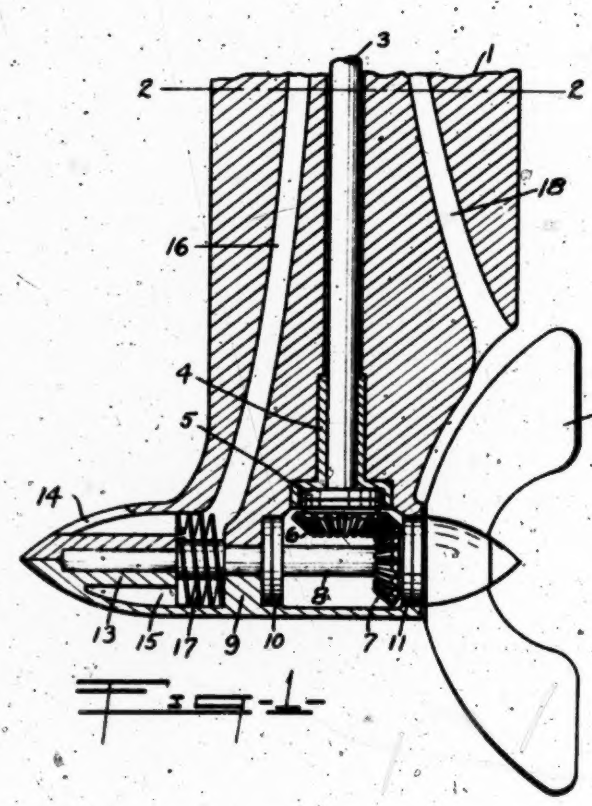


Fig-1-

INVENTOR
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MARINE PROPULSION DEVICE

Original No. 1,579,834, dated April 6, 1926, Serial No. 742,814, filed October 10, 1924. Application for reissue filed April 3, 1928. Serial No. 267,076.

This invention relates to improvements in marine propulsion devices, and particularly to the submerged gear case and propeller shaft housing assembly of the conventional outboard motor.

One object of the invention is to design a propeller shaft housing and gear case assembly having new and novel means for forcing the water to the water jacket of the motor and whereby the usual pump is eliminated.

Another object is to design power and propeller shaft housings of simple and substantial design, and in which water intake and overflow passages are cored in or piped to the water jacket of the motor.

A further object is to design a gear casing to eliminate the possibility of sand or water getting into the gears or propeller shaft bearings.

The above and other objects will appear as the specification progresses, reference being had to the accompanying drawings in which I have shown the preferred embodiment of my invention, and in which like reference numerals indicate like parts throughout the several views thereof.

In the drawings,—

Fig. 1 is a fragmentary vertical sectional view of a power shaft housing gear case and propeller shaft housing.

Fig. 2 is a section taken on the line 2—2 of Fig. 1.

Fig. 3 is a front view thereof.

Fig. 4 is also a sectional view similar to that shown in Fig. 2 showing an alternate form of construction.

It has always been somewhat troublesome in outboard motors to provide simple means for forcing water up to cool the cylinders of portable motors of this type, as it generally necessitates a force pump equipped with valves operated by a cam or other device, and these valves stick and grind due to the sand and foreign matter taken into the pump with the water, the pump is therefore short lived, expensive to build, and is subject to clogging, it also necessitates a bulky design which must be forced through the water, with the consequent loss of power, and these objectionable features I have overcome by eliminating the pump and providing a structure not affected by sand and foreign matter and which has no movable parts.

In my improved design I provide a vertically extending power shaft housing which can be cast of aluminum or other light metal, this is preferably wedge shaped as shown, the edges being thin and sharp to eliminate water resistance and being mounted in a well known manner to turn about a vertical axis forming a rudder for steering, the housing extending both above and below the normal water line.

A power shaft 3 is rotatably mounted in this power shaft housing which is cored to receive it, and a bushing 4 is fitted to the lower end thereof which is cored to form a gear casing, a thrust bearing 5 being mounted in this bushing, and a bevel gear 6 is keyed on the lower end of the power shaft, meshing with and driving a bevel gear 7 mounted on a propeller shaft 8, which is journaled in a propeller shaft housing 9, this housing is cylindrical in shape, the top half being cast integral with the power shaft housing, the lower half being machined and fitted thereto, and is held in place by screws (not shown) in the usual manner. Bearings 10 and 11 are mounted in this housing, and the propeller shaft 8 is journaled thereon, the one end projecting beyond the housing and having a propeller member 12 fixed thereon, the front end of the shaft being journaled in a sleeve bearing 13 formed in the housing proper. It will also be obvious that the front end or nose of the housing can be formed separate and threaded to engage the main body, or it can be bolted thereto if desired, this is however merely a detail of construction.

An intake port or opening 14 is located in the end or nose of the propeller shaft housing, and leads to a chamber 15 through which the propeller shaft extends, said chamber communicating with an upwardly extending passage 16 formed in the power shaft housing. A spiral 17 formed of thin metal, is mounted on the propeller shaft 8 in this chamber 15, and as the water enters through said port, the spiral forces it up this passage

and to the water jacket of the engine, (not shown).

A similar passage 18 is formed on the opposite side of the power shaft for accommodating the overflow or discharge, and opens directly adjacent the propeller and below the water line, locating the overflow at this point also has its advantages, as the displacement of water by the propeller sets up a partial vacuum to accelerate the circulation or flow of the water in the water jacket, further, when reversing with a motor where a conventional pump is used, the supply is either entirely cut off, or reduced to such extent as to be entirely insufficient. In my improved construction a full supply is assured regardless of the direction of rotation of the motor, as the reversing thereof merely reverses the direction of flow of water to the water jacket, the propeller forcing it into the passage 18, the spiral 17 forcing it out of the intake port above described.

In Fig. 4 of the drawings I have shown an alternate form of construction, the power shaft housing being pressed, with tubes of brass or copper secured therein for the propeller shaft and water passages, this makes a very light and economical housing, the principle being identically similar to that above described. It will also be obvious that a screen should be placed over the intake port to exclude chips, weeds and foreign matter.

From the foregoing description it will be obvious that I have perfected a very simple, substantial and economical marine propulsion device which is very efficient in operation, and is composed of a minimum number of parts.

What I claim is:

1. In a marine propulsion device provided with a vertically disposed knife edged wedge shaped power shaft housing, a propeller shaft housing, a power shaft in said power shaft housing, water intake and outlet passages adjacent the power shaft, and an intake port in the propeller shaft housing and communicating with said intake passage.

2. In a marine propulsion device provided with a vertically disposed power shaft housing, a longitudinally disposed propeller shaft housing integral therewith, water intake and outlet passages in said power shaft housing, an intake port in the propeller shaft housing and communicating with the intake passage, and a spiral interposed between said port and said passage for forcing water up said intake passage.

3. In a marine propulsion device formed with a vertically disposed power shaft housing, a longitudinally disposed propeller shaft housing integral therewith, a propeller journaled thereon, water intake and outlet passages in said housing, an outlet port opening directly adjacent the propeller, an intake port in the propeller shaft housing and communicating with the intake passage, and means mounted in the said housing for forcing water up the intake passage.

4. In a marine propulsion device provided with a power shaft housing, a propeller shaft housing formed integral therewith, intake and outlet passages in said power shaft housing, an intake port in the propeller shaft housing and communicating with the said intake passage, and a spiral interposed between said port and said passage.

5. In a marine propulsion device provided with a power shaft housing, a propeller shaft housing integral therewith, intake and outlet passages formed in said power shaft housing, an intake port in said propeller shaft housing and communicating with said intake passage, and a spiral interposed between said port and said passage for forcing water into said passage.

6. In a marine propulsion device provided with a vertically disposed wedge shaped power shaft housing having sharp edges, a gear casing on the lower end thereof, a propeller shaft housing, water intake and outlet passages adjacent the power shaft and below the normal water line, and an intake port in the propeller shaft housing and communicating with said intake passage.

7. In a marine propulsion device provided with a power shaft housing, intake and outlet passages therein, a power shaft journaled therein, a propeller shaft housing below said power shaft housing, a propeller shaft therein, and having driving connection with said power shaft, an intake port in the propeller shaft housing and communicating with the intake passage, and a spiral mounted on the propeller shaft and interposed in said passage.

8. In a marine propulsion device provided with a vertical power shaft housing, a propeller shaft housing integral therewith, intake and outlet passages in said housing, a power shaft journaled therein, and having driving connection with a propeller shaft journaled in the propeller shaft housing, a propeller mounted thereon, a spiral mounted on said shaft in the said housing, an intake port communicating with said intake passage, and a discharge port directly adjacent the propeller.

9. In a marine propulsion device provided with a vertically disposed power shaft housing, a longitudinally disposed propeller shaft housing formed integral therewith, intake and outlet passages formed in said housing and forming a continuous circuit with the water jacket of a motor, an intake port in the nose of the propeller shaft housing and communicating with the intake passage, and an outlet port in the power shaft housing directly adjacent the propeller.

10. In a marine propulsion device provided with a power shaft housing, a propeller

shaft housing integral therewith, a propeller shaft journaled therein, intake and outlet passages in said housing and forming a continuous circuit with the water jacket of a motor, an intake port in the propeller shaft housing, and a spiral mounted on the propeller shaft and interposed in said intake passage.

11. In a marine propulsion device provided with a power shaft having driving connection with a propeller shaft journaled in a propeller shaft housing, intake and outlet passages adjacent said power shaft, an intake port in said gear casing and connecting with said intake passage, and a spiral mounted on the propeller shaft and interposed in said intake passage.

12. In a marine propulsion device provided with a vertically disposed knife edged symmetrical wedge shaped power shaft housing a propeller shaft housing formed integral therewith, and intake and discharge passages in said propeller shaft and power shaft housings opening below the normal water level.

13. In a device of the type described, in combination, a propeller shaft housing for an outboard motor, a propeller shaft in said housing, and a water impeller carried by and directly driven by said propeller shaft, said water impeller being completely enclosed by said housing, the nose of said housing being provided with an opening exposed to the force of the flow of water relative to said housing leading to said impeller, and said housing being provided with a passage for the discharge of water from said impeller.

14. In a device of the type described, in combination, a vertically disposed power shaft housing, a horizontally disposed propeller shaft housing carried by said power shaft housing, a power shaft in said power shaft housing, a propeller shaft in said propeller shaft housing, gears connecting said shafts, said propeller shaft housing being formed to also provide a pump chamber, said propeller shaft housing being provided with an opening leading into said chamber opening toward the normal path of water flowing toward said propeller shaft housing, a water impeller in said chamber carried by said propeller shaft and fixed against rotation relative thereto, and an engine water inlet passage in said housings for receiving water from said impeller.

15. In a marine propulsion device, in combination, a power shaft housing, a propeller shaft housing carried thereby and disposed at substantially right angles thereto, each of said housings being provided with a bore, shafts in said bores operatively connected to each other, the bore in said propeller shaft housing being enlarged adjacent the nose thereof to form a chamber surrounding the shaft therein, a water impeller of the single unit type secured to said shaft within said chamber for equal rotation therewith, a water inlet for said chamber opening on said nose in a direction to receive the force of water having a relative normal flow towards said device, and an engine water inlet passage extending from said chamber.

16. In an outboard motor construction, in combination, a vertically disposed power shaft housing, a horizontally disposed propeller shaft housing connected to the lower end thereof, a power shaft in said power shaft housing, a propeller shaft in said propeller shaft housing, a gear on said power shaft, a gear on said propeller shaft meshing with the first mentioned gears, said gears being enclosed by said housing, a water impeller of the single member type secured to said propeller shaft within said propeller shaft housing, said impeller being substantially no larger in diameter than said gear on said propeller shaft, an inlet passage leading to said impeller, and an outlet passage leading from said impeller.

17. In an outboard motor construction, in combination, a vertically disposed power shaft housing, a horizontally disposed propeller shaft housing connected to the lower end thereof, a power shaft in said power shaft housing, a propeller shaft in said propeller shaft housing, a gear on said power shaft, a gear on said propeller shaft meshing with the first mentioned gears, said gears being enclosed by said housing, a water impeller of the single rotating member type fixed to said propeller shaft in concentric relation therewith within said propeller shaft housing, said impeller being substantially no larger in diameter than said gear on said propeller shaft, an inlet passage leading to said impeller, and an outlet passage leading from said impeller.

18. In a marine propulsion device provided with a vertically disposed power shaft housing, a longitudinally disposed propeller shaft housing formed integral therewith, intake and outlet passages formed in said housing and forming a continuous circuit with the water jacket of a motor, the intake passage being disposed between the front edge of the housing and the shaft bore therein and terminating in an intake port in the nose of the propeller shaft housing, and the outlet passage being disposed between the rear edge of the housing and the shaft bore therein and terminating in an outlet port in the power shaft housing directly adjacent the propeller.

19. An outboard motor assembly wherein the propeller-carrying member forms a rudder for steering and is of stream-line construction throughout its height and extends to above the water line.

JAMES H. PIERCE.

Re. 18,118.—*James H. Pierce*, Bay City, Mich. MARINE PROPULSION DEVICE. Patent dated July 7, 1931. Disclaimer filed March 2, 1940, by the assignee, *Outboard, Marine and Manufacturing Company.*

Hereby disclaims the subject matter of claim 19 of said reissue patent.
[*Official Gazette March 26, 1940.*]

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Aug. 2, 1932.

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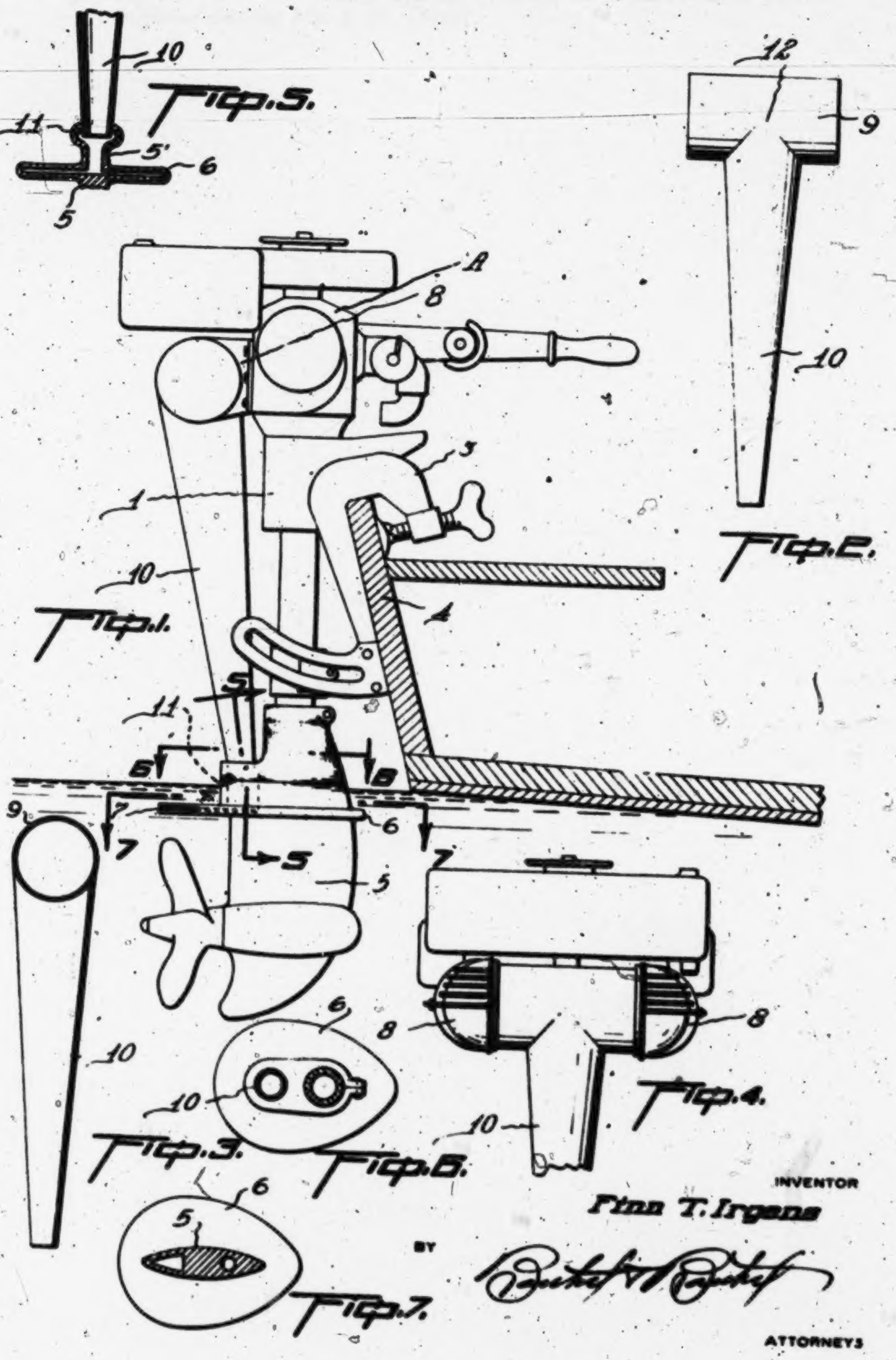
1,869,749

EXHAUST TUBE FOR INTERNAL COMBUSTION ENGINES

Filed Oct. 17, 1929



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Patented Aug. 2, 1932

1,869,749

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UNITED STATES PATENT OFFICE

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EXHAUST TUBE FOR INTERNAL COMBUSTION ENGINES

Application filed October 17, 1929. Serial No. 400,218.

The present invention pertains to a novel exhaust tube for an internal combustion engine, particularly in relation to an outboard motor of the opposed two cylinder, two-cycle type.

It is well known that a two-cycle engine, such as that used in outboard motors, exhausts and admits simultaneously, so that there is only a very slight pressure tending to discharge the exhaust. Consequently, if a straight exhaust pipe is used, a very heavy pulsation is set up therein, resulting in back pressure, particularly if the pipe is restricted. Such pulsation and back pressure cause a material drop in power.

In outboard motors where the exhaust takes place under water for the purpose of silencing, it is necessary to have an expansion chamber between the head of the engine and the submerged exhaust outlet. The present invention provides an effective expansion chamber in this position.

The principal objects of the invention are to increase the volume of the expansion chamber and to eliminate the pulsations which are set up in a straight exhaust pipe and which have a material effect on the power developed by the engine. This object is attained by tapering the pipe from the inlet end to the outlet end thereof, the inlet end being of larger cross section than in the case of a straight pipe. It has been found by test that a pipe of this character eliminates the above mentioned pulsations and also increases the volume of the exhaust expansion chamber.

The invention is fully disclosed by way of example in the following description and in the accompanying drawing, in which—

Figure 1 is a vertical elevation of an outboard motor equipped with the invention and applied to a boat which is shown in section;

Fig. 2 is a front or rear elevation of the exhaust tube;

Fig. 3 is an elevation at right angles to Figure 2;

Fig. 4 is a fragmentary rear elevation of the motor, showing the upper end of the exhaust tube; and

Figs. 5, 6 and 7 are sections on the lines 5—5, 6—6 and 7—7 respectively of Figure 1.

Reference to these views will now be made by use of like characters which are employed to designate corresponding parts throughout.

The numeral 1 indicates in general the usual motor structure which has a clamp 3 adapted for attachment to the transom 4 of a boat. The adjustments of this assembly are conventional and therefore need not be described here.

At the lower end of the motor structure is the usual propeller shaft housing 5 on which is formed an anti-cavitation plate 6, preferably as an integral part of the housing and of ovoid cross section.

The rear or trailing end of the plate is formed with a mouth 7 beneath its upper and lower surfaces. The details of this plate are described in the co-pending application of King and Lockwood, Serial No. 290,306, filed July 5, 1928 and allowed April 15, 1929.

To the cylinders of the engine is applied an exhaust manifold 8 which in turn communicates with the exhaust tube now to be described. The tube is of an approximate T-shape in elevation, as shown in Figure 2, and comprises a head 9 which is secured between and in communication with the ends of the exhaust manifold 8.

Due to the necessity of an expansion chamber as already outlined and the compact design of an outboard motor, it is not possible to provide such a chamber of comparatively large volume directly at the cylinder exhaust outlet. Nevertheless, there is considerable space between the power head A of the motor and the propeller shaft housing 5. This space is utilized to accommodate an expansion chamber of proper size, as will presently appear.

The tube proper is a tapered member 10 extending from the center of the head 9 to the propeller shaft housing, as indicated by the numeral 11, and communicating with the mouth 7 of the plate 6 through a passage 5′ in the housing. The tube 10 tapers from the head 9 to the casing 5, or in the direction of flow, and the ratio of the upper end area to

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the lower end area may vary from 4:1 to 36:1. In a given construction for example, the upper end of the tube has a diameter of 4½ inches at the point 12 where it merges into the center of the head 9, and a diameter of 1$\frac{11}{16}$ inches at the lower end.

The unit is in its best running condition when the anticavitation plate 6 is submerged about one inch, in which case the water line is between the plate and the lower extremity of the tube 10 as illustrated in Figure 1. This condition is realized by properly building the boat and properly mounting the motor thereon. The device will of course operate if more deeply immersed, but in such case the heavier parts of the propeller shaft housing and the exhaust tube will be submerged. Inasmuch as these parts are not stream line, as illustrated in Figure 6, the resistance will be increased.

As already indicated, it has been found that this type of tube eliminates the pulsations which occur in a straight exhaust pipe and further increases the volume of the exhaust expansion chamber.

Although a specific embodiment of the invention has been illustrated and described, it will be understood that various alterations in the details of construction may be made without departing from the scope of the invention, as indicated by the appended claims.

What I claim is:—

1. The combination with a marine engine having an exhaust port, of a tapered exhaust pipe connected with said port and leading to a point beneath the surface of the water, said pipe having a submersible outlet movable in accordance with the operation of said engine and directed rearwardly with reference to its path of movement, whereby to eliminate back pressure from said pipe, the tapering form of said pipe being adapted to destroy its resonance to pulsation frequencies.

2. The combination with a two-cycle, two-cylinder engine having exhaust ports, of a manifold member connected with the respective ports, and an exhaust pipe leading from said manifold member and of such dimensions as to be resonant to the frequencies of pulsations occasioned therein by engine exhaust through said ports, said pipe having a tapered form destructive to said pulsations.

3. In an outboard motor having a submersible lower unit provided with a rearwardly directed exhaust discharge port, the combination of a two-cylinder, two-cycle engine, and a tapered exhaust pipe leading from the cylinders of said engine through the rearwardly directed discharge port of said lower unit, whereby to relieve back pressure and destroy frequency pulsations.

In testimony whereof I affix my signature.

FINN T. IRGENS.

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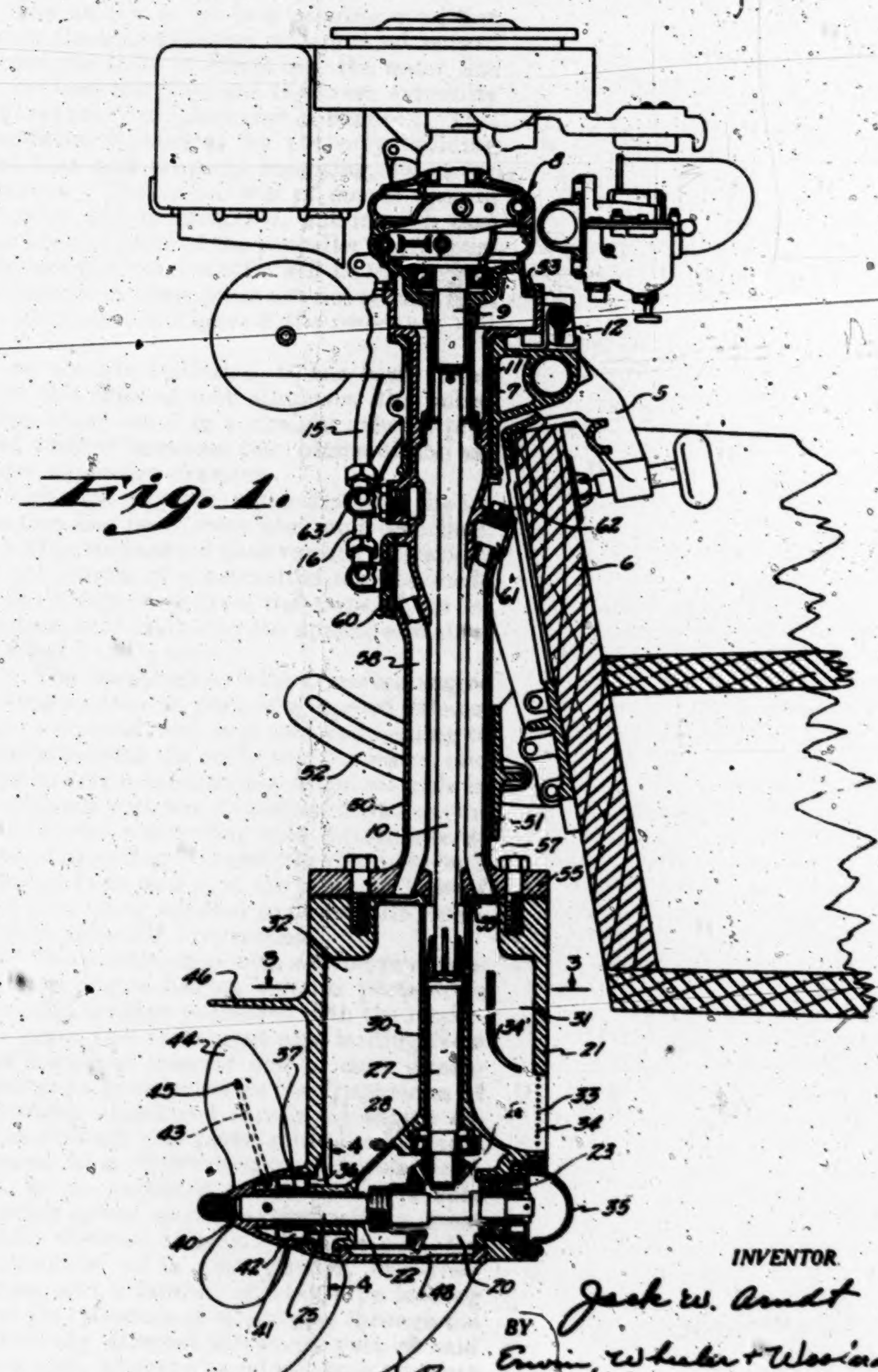
Sept. 6, 1932. J. W. ARNDT 1,875,912

COOLING SYSTEM FOR MARINE ENGINES

Filed Jan. 30, 1928 2 Sheets-Sheet 1



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Sept. 6, 1932. J. W. ARNDT 1,875,912

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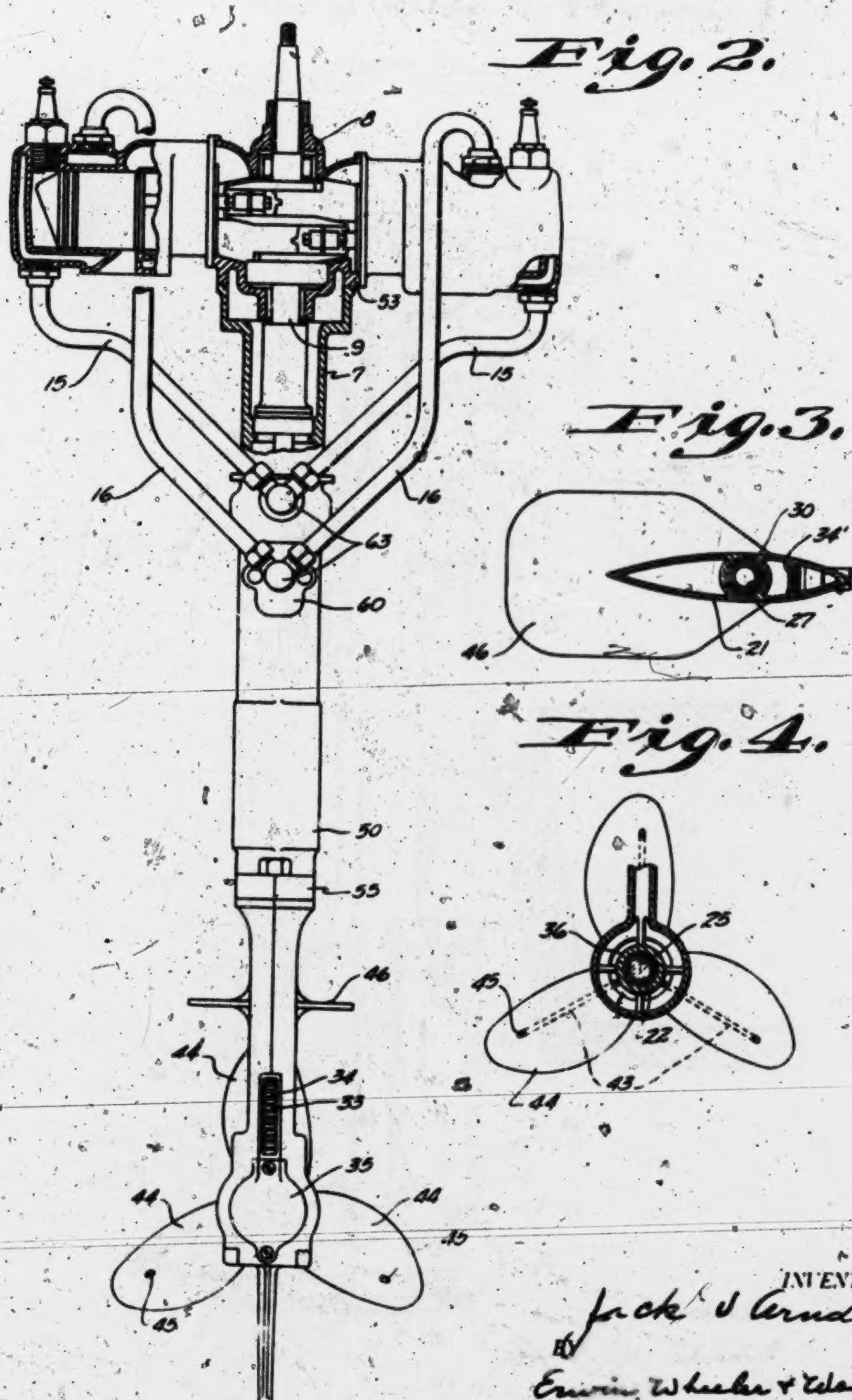
COOLING SYSTEM FOR MARINE ENGINES

Filed Jan. 30, 1928 2 Sheets-Sheet 2



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Patented Sept. 6, 1932 335 1,875,912

UNITED STATES PATENT OFFICE

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COOLING SYSTEM FOR MARINE ENGINES

Application filed January 30, 1928. Serial No. 250,611.

This invention relates to improvements in cooling systems for marine engines and particularly to an improved means for circulating cooling water through the jacket and water supply connections of the internal combustion engine of an outboard motor.

It is the primary object of the invention to provide improved means for supplying cooling water to radial passages in a propeller, whereby such water will be centrifugally eliminated to draw a fresh supply of coolant through the cooling system without requiring the use of extraneous pumps or any apparatus which will materially interfere with the normal and substantially streamlined displacement of water in the free movement of the device therethrough.

It is a further object to provide a novel and improved type of water inlet designed to receive water for cooling purposes with a minimum displacement of water through which the device is moving.

In all devices heretofore used for circulating cooling water through the jacket systems of outward motor engines there has been considerable displacement of water in such a way as to add materially to the power required for propulsion. Pumps or other parts projecting from the otherwise stream-lined surface of the submersible portion of the motor have produced power-absorbing eddy currents and similar effects have resulted from poorly designed water inlets ports. By using radial passages in the propeller blades and carefully designed communicating passages for water inlet and outlet I have succeeded in eliminating not only the moving parts incidental to pump operation, but also the eddy currents and awkward designs of previous structures in which the elimination of pumps has been attempted.

It is another important purpose of this invention to avoid heating the lubricant in the propeller drive gear housing and to avoid possible leakage of water therein, while also preserving a solid or substantial propeller shaft, by supplying coolant to the propeller exhausting pump passages through the propeller hub outside of the projected periphery of the propeller shaft so that the design or operation of the shaft and its bearings is in no wise altered.

In the drawings:

Figure 1 is a vertical section through a device embodying this invention.

Figure 2 is a front elevation of the motor without its bracket, the engine being shown in section.

Figure 3 is a section in the plane designated at 3—3 in Figure 1.

Figure 4 is a detail in section taken in the plane indicated at 4—4 in Figure 1.

Like parts are identified by the same reference characters throughout the several views.

The outboard motor in which this invention is embodied for illustrative purposes is of a well known type including a bracket 5 for attachment to the transom of boat 6. The engine is pivoted for steering purposes, being provided with a bearing sleeve 7 projecting down from its crank case 8 concentrically with aligned crank shaft 9 and drive shaft 10. The sleeve is journaled in bearing element 11 of the bracket. A latch 12 releasably engages the crank case 8 with the bracket to restrain it against steering movement during starting. Counter-clockwise oscillation of the latch from the illustrated engagement with the notched bracket releases the motor for normal steering.

The cylinders 13 are provided with the usual jackets 14 to which coolant is supplied through pipes 15 and withdrawn through pipes 16. The present invention relates to the shaft and gear housing assembly and the means for circulating coolant through the cooling system including the jackets and pipes above described.

The submersible housing element comprises integrally a gear casing 20 and a shell 21 of stream-line contour in horizontal cross section which rises thereabove approximately to the normal water line. The casing 20 is provided with bearings at 22 and 23 for the propeller shaft 25 which is driven by gearing 26 from drive shaft extension 27. There is also a bearing at 28 for such extension.

The stream-lined shell 21 comprises a part of the drive shaft housing. It is divided by

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a bearing partition 30 into front and rear compartments 31 and 32. Within the bearing partition or drive shaft casing 30, the drive shaft 10 is splined for convenience to extension 27. For the purposes of this discussion, the two shaft elements may be regarded as one.

The front chamber 31 has a water inlet port at 33 in the form of a vertically elongated slot centrally disposed at the apex of the converging walls of shell 21. A screen is conveniently and strongly made by casting transverse rods 34 which span the slot like port. A baffle 34′ guides the incoming stream upwardly to prevent eddy currents while permitting circulation so as to prevent accumulations of foreign matter.

The location of the inlet slot is such that its screen is more protected than it would be on the projecting cap 35 for bearing 23. It is so shaped and located where foreign matter will not lodge because of the divided stream of water which passes at either side. Yet the movement of the devices will produce a powerful pressure causing a stream to enter the narrow port.

The chamber 32 has an outlet port at 36 which is annular and surrounds bearing 22. The bearing bushing preferably projects along the propeller shaft so that its packing 37 will readily be accessible upon removing the propeller. The fact that the discharge stream of coolant is kept outside of the gear casing and of the propeller shaft avoids the possibility of heating lubricant or diluting it with water or weakening the propeller shaft.

The propeller 40 has a hub skirt 41 rotatably, although not necessarily closely, fitted to the submersible housing about the outlet port 36. The annular chamber 42 within the propeller hub communicates directly with the port 36 and also with radial passages 43 in each of the propeller blades 44 which issue from the forward faces of the blades at 45. During the rotation of the propeller, the water in passages 43 is centrifugally expelled to induce a rather powerful current through chambers 31 and 32 and the cooling system to which they are connected as hereinafter described.

The submersible housing carries an integral cavitation plate 46 intermediate top and bottom and a skeg 47 attached to a closure member 48 whereby the gearing is readily accessible for lubrication and inspection.

The submersible housing and parts associated therewith as aforesaid are dirigible unitarily with the engine, being connected therewith by an intermediate housing element 50. This element is tubular for bearing in the abutment block 51, the adjustment of which along the segmental guide arms 52 of bracket 5 determines the upright position of the motor. The upper end of the housing element 50 comprises sleeve 7 already described and the element is secured thereby to the crank case at 53. The lower end of the upper housing element carries a cover plate 55 conforming in contour with the housing shell 21 to the top of which it is bolted.

Integrally cast into the housing element 50 are inlet and outlet water pipes 57 and 58 which register and communicate with inlet and outlet chambers 31 and 32. Between these pipes is the drive shaft 10 which enters casing sleeve 30 through a boss 59 which centers the housing elements.

At their upper ends the pipes 57 and 58 terminate in fittings from which branch pipes 15 and 16 lead to and from the water jackets as already described. The construction of outlet pipe fitting 60 will be obvious. Inlet pipe 57 terminates in an annular manifold 61 provided with a clean-out plug 62. The purpose of the manifold is to carry the inlet stream to the back of the motor where the Y-fitting 63 connects to pipes 15 leading to the bottoms of the jackets.

The description of the system and circulating means is now complete. Water enters port 33 under such pressure as results from movement of the device and from subatmospheric pressure induced at the outlet by the centrifugal impeller incorporated in the propeller. The water then traverses chamber 31, tube 57, manifold 61, fitting 63, pipes 15, and jackets 14 to return by pipes 16, fitting 60, tube 58, chamber 32, port 36, chamber 42, and radial discharge passages 43 and ports 45 to the body of water whence it came.

It will be clear that the construction described offers numerous advantages and the objects briefly outlined above are fully satisfied.

I claim:

1. In a marine power plant having a cooling system, the combination with a propeller shaft, of a member providing a bearing therefor and a port adjacent said bearing communicating with said system, a propeller on said shaft abutting the ported portion of said member and provided with an apertured hub adapted in rotation to receive a liquid directly from said port, said propeller having a radial passage from said port for the discharge of such liquid.

2. A marine power plant comprising the combination with an engine cooling system and an engine driven submersible propeller shaft, of a member having a bearing supporting said shaft and provided with a port communicating with said system and opening adjacent said shaft, a propeller having an apertured hub communicating outside of said bearing with said port and revoluble with reference thereto, and blades provided

with radial discharge passages leading from said aperture.

3. A marine power plant comprising the combination with a water cooled engine having a jacket and a propeller shaft, of a support for said shaft provided with a bearing and a passage communicating with said jacket and opening outside of the bearing, a propeller having radially passaged blades and a hub portion revoluble adjacent said support and chambered to afford communication outside of said shaft between the passage of said support and the passages of said blades, and means providing an inlet passage from a normally submersible part of said power plant to said jacket.

4. The combination with the cooling system of the engine of a marine motor including a submersible gear housing provided with inlet and outlet ports, of conduit means connecting said system with said ports, a propeller shaft projecting from said housing, and a propeller on said shaft having a hub portion provided with an aperture registerable with said outlet port for the operative reception of water directly therefrom and a blade portion with an outwardly opening passage communicating with said aperture whereby centrifugally to expel water so received.

5. In a marine power plant the combination with an engine having a cooling system and a propeller shaft, of means for circulating water through said cooling system comprising a propeller on said shaft having a radial delivery passage and a ported hub, a conduit leading to said system, and a conduit leading from said system directly to said port wholly outside of said shaft and having a terminal portion with respect to which said hub port is revoluble and in operative communication.

6. In a marine power plant, the combination with an engine having a cooling system and an upright drive shaft, of a propeller shaft, gearing connecting said shafts, a submersible gear housing enclosing said gearing and providing a bearing for said propeller shaft, and means for circulating through said system a portion of the water about said housing, said means including a propeller on said shaft having a radial impeller passage and means outside of said housing and said shaft providing a conduit for liquid between said passage and said system.

7. In a marine power plant, the combination with an engine having a cooling system with a normally submerged inlet, of a propeller shaft driven from said engine, a bearing member provided with a bearing and a packing gland about said shaft and an exhaust port outside of said bearing communicating with the outlet of said system, and a propeller on said shaft and provided with a chamber with a skirt rotatably abutting said member and adapted to receive coolant from said exhaust port, said chamber having radially opening apertures for centrifugal expulsion of liquid therefrom wholly extraneously of said bearing.

8. In an outboard motor, the combination with an engine having a cooling system, an upright drive shaft, a propeller shaft, gearing connecting said shafts, a submersible gear housing providing a bearing for said shaft, and a drive shaft housing, of a propeller providing coolant exhaust passages in its blades and a chambered hub rotatably fitted to said gear housing, and passage means providing inlet and outlet communication with said cooling system and leading therefrom to said hub wholly outside of said gear housing and bearing.

9. In an outboard motor, the combination with an engine and a cooling system; of a drive shaft, propeller shaft and gearing; a housing for said gearing provided with a bearing for said propeller shaft and with a stream-lined housing element for the lower part of said drive shaft having inlet and outlet passages wholly outside of said gear housing and inlet and outlet ports of which the latter is adjacent and outside of said bearing; a propeller on said shaft provided with radial discharge conduits adapted during propeller rotation to receive water from said outlet port; and a drive shaft housing supporting said first mentioned housing from said engine and carrying conduit means communicating with said passages and said system.

10. In a device of the character described, the combination with a submersible gear housing; of an upwardly extending drive shaft housing elongated from front to rear and provided with forward and rearward chambers, the former having forwardly converging walls formed to provide an inlet port at the apex, and the latter having an outlet port at the rear of the outside of said gear housing; a cooling system connected between said chambers; and means for circulating coolant through said chambers and system, said means comprising a propeller having a centrifugal delivery passage and a hollow hub fitted about said outlet port and adapted to withdraw liquid therefrom.

11. In a device of the character described, the combination with an engine having a cooling system, of a shaft housing means comprising an upper section provided with conduits and a lower section secured thereto and provided with ported forward and rearward inlet and outlet chambers and an intermediate drive shaft bearing partition; and a gear housing connected with said lower section and wholly closed from said chambers; together with a propeller shaft projecting from said gear housing adjacent the port of said outlet chamber and a propeller provided with centrifugal impeller passages

and a collecting port registering with said outlet port and adapted to draw liquid therefrom.

12. As a new article of manufacture for encasing outboard motor shafting and gearing, a stream-lined submersible housing providing a coolant passage having an inlet port in the form of a vertically elongated slot centered at the forward apex of the housing intermediate the top and bottom thereof.

13. As a new article of manufacture for encasing outboard motor shafting and gearing, a submersible housing providing a closed gear case at its lower end, a shaft case extending thereabove, water inlet and outlet passages at before and behind said shaft case, a bearing at the rear of said gear case, and an annular port opening from said outlet passage about said bearing.

14. An outboard motor including the combination with an engine having a cooling jacket and a drive shaft, of a housing element comprising a gear casing and having inlet and outlet water passages and an intermediate drive shaft case extending thereabove, and a second housing element connecting said first element with said engine and provided with water passages communicating with said jacket and with an intermediate drive shaft case all registering with the corresponding parts of said first mentioned element, together with a propeller shaft projecting rearwardly from said gear casing and operatively connected with said drive shaft, said outlet passage being ported adjacent said propeller shaft, and a propeller having a skirt rotatably fitted to said first element about said shaft and port and blades provided with passages opening radially from within said skirt.

15. The combination in an outboard motor, of a submersible unit having a propeller shaft gear housing portion and a drive shaft housing portion, said latter portion having forwardly converging wall surfaces and an interior water supply passage opening through the forward apex of said wall surfaces wholly above said first mentioned portion.

16. In an outboard motor, a submersible unit having stream lined exterior surfaces converging forwardly and including a water passage having an inlet disposed at the forward apex of said surfaces within the zone of pressure created in the movement of said unit, the apex of said surfaces being linear in an upright direction and said inlet being transversely narrow and vertically elongated whereby pressures thereon will be approximately uniform throughout the area of said inlet.

JACK W. ARNDT.

June 11, 1929.

H. L. JOHNSON

1,716,962

WATER PROPULSION DEVICE

Filed Aug. 25, 1926

Fig. 1.

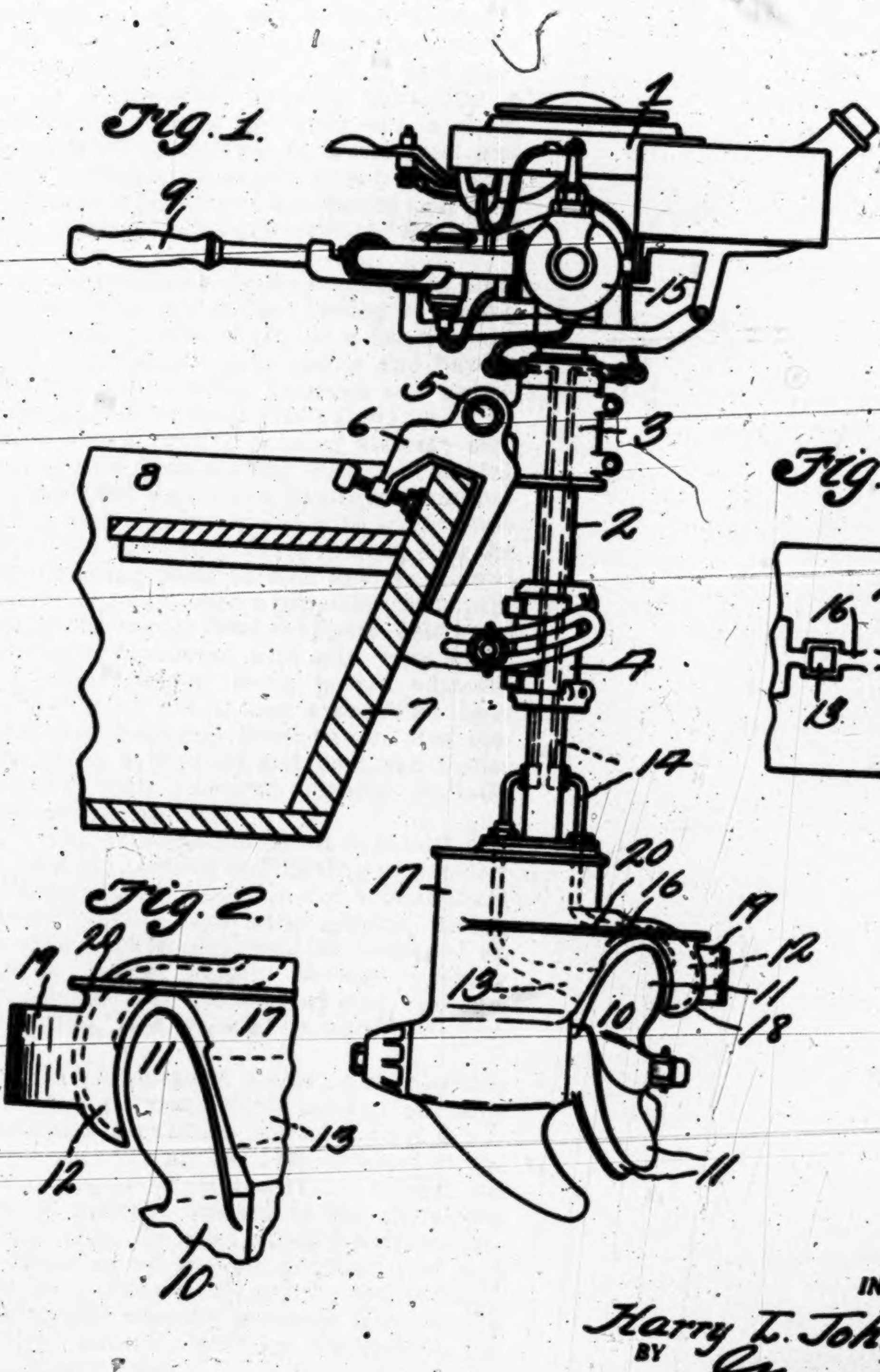

Fig. 3.

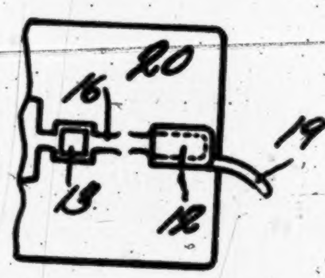

Fig. 2.

INVENTOR.

Harry L. Johnson

BY George J. Ottock

ATTORNEY.

Patented June 11, 1929. 1,716,962

UNITED STATES PATENT OFFICE.

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WATER PROPULSION DEVICE.

Application filed August 25, 1926. Serial No. 131,534.

The invention relates to water propulsion devices, particularly of the outboard or inboard motor type. In the present instance, the invention is illustrated as applied to an outboard motor, particularly of the pivotally mounted type wherein the motor as a whole is pivotally moved during the steering operation, and has for its object to provide the lower end of the motor rearwardly of the propeller with a water resisting plate against which the water is forced by the propeller, and which plate counteracts the side movement of the motor as well as the pivotal movement thereof in its bearing, thereby allowing the operator to steer a straight course while holding the tiller and without the strain on the hand, incident to the side throw referred to.

A further object is to provide a deflecting plate rearwardly of the propeller, said deflecting plate curving rearwardly and outwardly in the direction of rotation of the propeller, and against which plate water projected rearwardly by the propeller engages and counteracts the pivotal movement of the motor, thereby relieving the strain on the operator's hand while gripping the tiller during a steering operation.

A further object is to provide the lower end of the drive shaft casing with a casting which supports the propeller and propeller shaft and said casting with a member arching the upper side of the propeller and having intake and discharge ports leading to the engine jacket, and a water resisting deflecting plate carried by said casting rearwardly of the propeller blade, and by the rear portion of the portion of the casting which arches the propeller. Also to provide the casting adjacent the upper side of the propeller with an anti-cavitation plate, and which plate is preferably formed integral with the casting, and additionally braces the portion of the casting arching the upper side of the propeller.

A further object of my invention resides in providing the propeller-carrying-casing with an anti-cavitation plate arranged so as to directly overlie the path of travel of the propeller blades, and in forming the exterior surfaces of this casing relatively broad and smooth and extending them upwardly well above the plane of the anti-cavitation plate, whereby not only to permit the housing to travel through the water with minimum resistance and to provide rudder surfaces to assist in steering, but also to permit the flowing water to pass closely about the rear of the housing above the anti-cavitation plate to assist in preventing cavitation at the propeller. A further feature of this aspect of my invention resides in the fact that the propeller-carrying-casing as thus constructed, provides an enclosing housing for the drive and propeller shafts, the geared connections therebetween, and also for one or more water passages leading to the water jacket of the engine and terminating on the exterior face of the housing below normal water level, by which arrangement the propeller-carrying-casing can move through the water with minimum resistance and cooling water can be delivered to the water jacket of the motor.

With the above and other objects in view the invention resides in the combination and arrangement of parts as hereinafter set forth, shown in the drawings, described and claimed, it being understood that changes in the precise embodiment of the invention may be made within the scope of what is claimed without departing from the spirit of the invention.

In the drawing:—

Figure 1 is a side elevation of an outboard motor showing the devices applied thereto.

Figure 2 is a detail view in elevation of the right side of the deflecting plate and portions of the adjacent mechanism.

Figure 3 is a bottom plan view of a portion of the anti-cavitation plate and the water resisting plate.

Referring to the drawing the numeral 1 designates the motor, which motor is provided with a downwardly extending drive shaft casing 2, which drive shaft casing is rotatably mounted in a bearing member 3 and 4 in the usual manner, and the motor as a whole is pivotally connected at 5 to the bracket 6, and which bracket in turn is securely clamped to the rear end 7 of a boat 8. In motors of this general type, the motor as a whole is pivotally moved in the bearing members 3 and 4 during a steering operation, and at which time the operator grasps the tiller 9. It has been found that during a steering operation it is necessary for the

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operator to maintain a firm grip on the tiller 9, and the hand and arm of the operator is under strain, particularly in long runs, and which strain is caused by the tendency of pivotal movement of the motor as a whole in the direction of throw of the propeller 10, and which throw not only has a tendency to cause the motor as a whole to have a pivotal movement, but also the rear end of the boat to have a lateral movement in the direction of throw of the propeller.

Propeller 10 is driven in the usual manner and in the present case the blades 11 thereof pass between the intake port 12 and the discharge port 13. During the rotation of the propeller, water is driven through the port 12 through the pipe 14 to the water jacket 15 of the engine, and is sucked as well as discharged through the port 13 by the propeller blades as they pass through the arched portion 16 of the casing 17. The arched portion of the casing 17 arches the upper side of the propeller and terminates rearwardly thereof in the portion 18. Extending rearwardly and outwardly from the portion 18 is a deflecting plate 19, and against which deflecting plate water forced rearwardly by the blades 11 of the propeller engages and counteracts the pivotal movement of the motor as a whole as well as the side throw, thereby relieving strain on the hand of the operator while grasping the tiller 9 during a steering operation. It will be noted that the deflecting plate 19 curves in the direction of the direction of rotation of the propeller, which causes the side throw and pivotal action, consequently the current of water which is projected rearwardly by the propeller blade will impart sufficient power on the curved plate 19 to counteract the pivotal tendency as well as the side throw. It will be noted that plate 19 curves to the right, however it is to be understood with a left hand propeller the plate may be reversed in its position.

Port 12 extends upwardly through the arched portion 16 of the casing 17 and formed integral with said arched portion 16 and casing 17, and located adjacent the upper side of the propeller is an anti-cavitation plate, which plate prevents cavitation and at the same time forms a brace for the arched portion 16 of the casing and eliminates the necessity of making the arch 16 relatively heavy, which in turn would cause a bulky structure and unnecessary resistance as the motor moves through the water.

The propeller carrying casing 17 which is rigidly mounted on the lower end of the tubular sleeve or casing 2 surrounding the drive shaft forms a housing for the lower end of said depending drive shaft, for the propeller shaft on which the propeller 10 is mounted, and for the geared connections therebetween. It also houses the water discharge passage 12 and the water intake passage 13 which extend upwardly therethrough and connect with suitable passages within the enclosing casing 2 leading to the jacket of the motor. This propeller-carrying-casing 17 is provided with relatively broad smooth and unbroken exterior surfaces both below and above anti-cavitation plate 20. This plate 20 preferably directly overlies the uppermost path of travel of the propeller blades 11, and it will be seen that the outer walls of this casing extend from the barrel-like portion 21 of the casing upwardly considerably above the anti-cavitation plate. In fact, the anti-cavitation plate is located substantially midway the top of the casing and the barrel-like portion of the casing in which the propeller shaft is directly mounted. By means of this construction, when the device is propelling the boat through the water, the water will flow with minimum resistance past these relatively smooth and substantially stream-line surfaces, thereby cutting down resistance to a minimum. By extending these smooth surfaces of the casing upwardly for a considerable distance above the anti-cavitation plate 20, the water flowing past the surfaces of the casing which are above the anti-cavitation plate will tend to follow the wall surfaces at the rearmost part of the casing and will flow inwardly and rearwardly above and over the anti-cavitation plate, thus creating a substantial body of flowing water directly over the cavitation plate and thus assisting the latter in preventing the formation of air pockets or cavitation at the propeller. In addition, by thus forming this propeller-carrying-casing with these relatively smooth walls which extend a considerable distance upwardly and also rearwardly, I provide relatively broad surfaces giving a rudder effect to assist the propeller in its steering movements as for instance when the housing is angularly turned to steer the boat in different directions.

From the above it will be seen that means is provided in connection with an outboard motor whereby the pivotal action of the motor as well as the side throw incident to the rotation of the propeller is obviated, consequently strain on the helmsman is relieved. It will also be seen that the deflecting plate 19 may be formed integral with the casing 17, as well as the anti-cavitation plate, consequently can be made in a single casting, thereby reducing the cost of manufacturing to a minimum.

The invention having been set forth what is claimed as new and useful is:

1. The combination with a pivotally mounted outboard motor, a rotatable propeller carried by said motor, a casing, a member carried by said casing and arching the side of the propeller and having intake and discharge ports, of a deflecting plate carried

by said member arching the propeller and located rearwardly of the propeller, said deflecting member extending outwardly in the direction of rotation of the propeller.

2. The combination with an outboard motor, a propeller carried by said motor, a casing, a member carried by said casing and arching the upper side of the propeller and having intake and discharge ports, and a deflecting plate carried by said arching member and disposed rearwardly of the propeller and extending in the direction of rotation of said propeller.

3. The combination with the lower end of an outboard motor, a propeller carried by said lower end, of a member arching said propeller and terminating rearwardly thereof, a deflecting plate carried by said member rearwardly of the propeller, said deflecting plate extending laterally in the direction of turn of the propeller in constant relation to said propeller.

4. The combination with a pivotally mounted outboard motor having a propeller, of a water deflecting plate disposed adjacent said propeller and forming means whereby pivotal movement of the propeller is obviated in the direction of turn of the propeller.

5. The combination with an outboard motor pivotally mounted and having a propeller, of means disposed rearwardly of the propeller and forming water resisting means whereby pivotal action of the motor in the direction of turn of the propeller is prevented as the motor moves through the water.

6. The combination with an outboard motor having a propeller shaft casing, a propeller, a member arching one side of the propeller, of an anti-cavitation plate carried by the casing and the member arching the propeller and located above the propeller.

7. The combination with an outboard motor having a propeller shaft casing, a propeller, a member arching one side of the propeller, a water resisting member carried by said arching member and extending in the direction of rotation of the propeller, of an anti-cavitation plate carried by the casing and the arching member.

8. The combination with an outboard motor casing, a propeller, a member carried by the casing and arching the propeller and having intake and discharge ports, a water resisting member carried by the arching member and an anti-cavitation plate carried by the casing at opposite sides thereof and by the member arching the propeller.

9. A propulsion device for water vehicles comprising a stationary support carrying a bearing, a drive shaft casing mounted to turn in said bearing, a motor having its drive shaft disposed within the drive shaft casing and said shaft passing downwardly through said casing, a housing mounted on the lower portion of the drive shaft casing and turnable therewith for steering, said housing being formed with a substantially horizontal barrel-like portion, a propeller shaft mounted within said barrel-like portion, and having a driving connection with the motor drive shaft, a propeller on said propeller shaft, said housing extending upwardly from said barrel-like portion and provided considerably below its top with an anti-cavitation plate extending rearwardly therefrom and overlying the path of forward travel of the propeller blades, and said housing having substantially vertical internal inlet and outlet passages leading to and from the water jacket of the engine both passages opening below normal water level.

10. A propulsion device for water craft comprising a stationary support carrying a bearing, a drive shaft casing mounted to turn in said bearing, a motor mounted on the upper end of said drive shaft casing with its drive shaft disposed within the drive shaft casing, said shaft passing downwardly therethrough, a housing mounted on the lower portion of the drive shaft casing and turnable therewith for steering, said housing being formed with a substantially horizontal barrel-like portion adapted to house the propeller shaft and its driving connection with the motor drive shaft, a propeller on said propeller shaft, said housing extending upwardly from said barrel-like portion and provided with an anti-cavitation plate extending rearwardly therefrom and overlying the forward path of travel of the propeller blades, said housing having smooth and unbroken outer wall surfaces at each side thereof extending upwardly from the said barrel-like portion to said plate and upwardly well above said plate to the top of the housing, and said housing having substantially vertical internal inlet and outlet passages leading to and from the water jacket of the engine both passages opening below normal water level.

11. A propulsion device for water craft comprising a stationary support carrying a bearing, a drive shaft casing mounted to turn in said bearing, a motor mounted on the upper end of said drive shaft casing with its drive shaft disposed within the drive shaft casing and said shaft passing downwardly therethrough, a housing mounted on the lower portion of the drive shaft casing and turning therewith, said housing including a substantially horizontal barrel-like portion, a propeller shaft mounted within said barrel-like portion and having a driving connection with the motor drive shaft, a propeller on said propeller shaft, said housing extending upwardly

from said barrel-like portion and provided well below its top with an anti-cavitation plate extending rearwardly therefrom overlying the path of forward travel of the propeller blades and said housing having a substantially vertical internal passage leading to the water jacket of the engine, said passage opening at a point below normal water level.

12. A propulsion device for water craft having a stationary support carrying a bearing, a drive shaft casing mounted to turn in said bearing, a motor mounted on the upper end of said drive shaft casing with its drive shaft disposed within the drive shaft casing and said shaft passing downwardly therethrough, a housing mounted on the lower portion of the drive shaft casing and turnable therewith for steering, said housing being formed with a substantially horizontal barrel-like portion, a propeller shaft mounted within said barrel-like portion and having a driving connection with the motor drive shaft, a propeller on said propeller shaft, said housing having an anti-cavitation plate extending rearwardly therefrom overlying the path of forward travel of the propeller blades, said housing having unbroken outer wall surfaces at each side extending upwardly from the said barrel-like portion to said plate and from said plate upwardly a substantial distance to the top of the housing, and said housing having a substantially vertical internal passage leading to the water jacket of the engine, said passage opening below the normal water level.

13. The combination of a water propulsion device having a vertically extending turnable propeller shaft casing provided with an internal water passage, opening bebelow normal water level, a propeller mounted thereon, means for turning said casing for steering, said casing having an anti-cavitation plate cast integral therewith and located in a plane above the propeller.

14. The combination of a water propulsion device having a vertically extending turnable propeller shaft casing provided with an internal water passage, opening below normal water level, a propeller mounted thereon, means for turning said casing for steering, said casing having smooth and unbroken walls extending upwardly and provided with an integrally cast anti-cavitation plate substantially midway of its height and in a plane above the propeller blades.

In testimony whereof I affix my signature.

HARRY L. JOHNSON.

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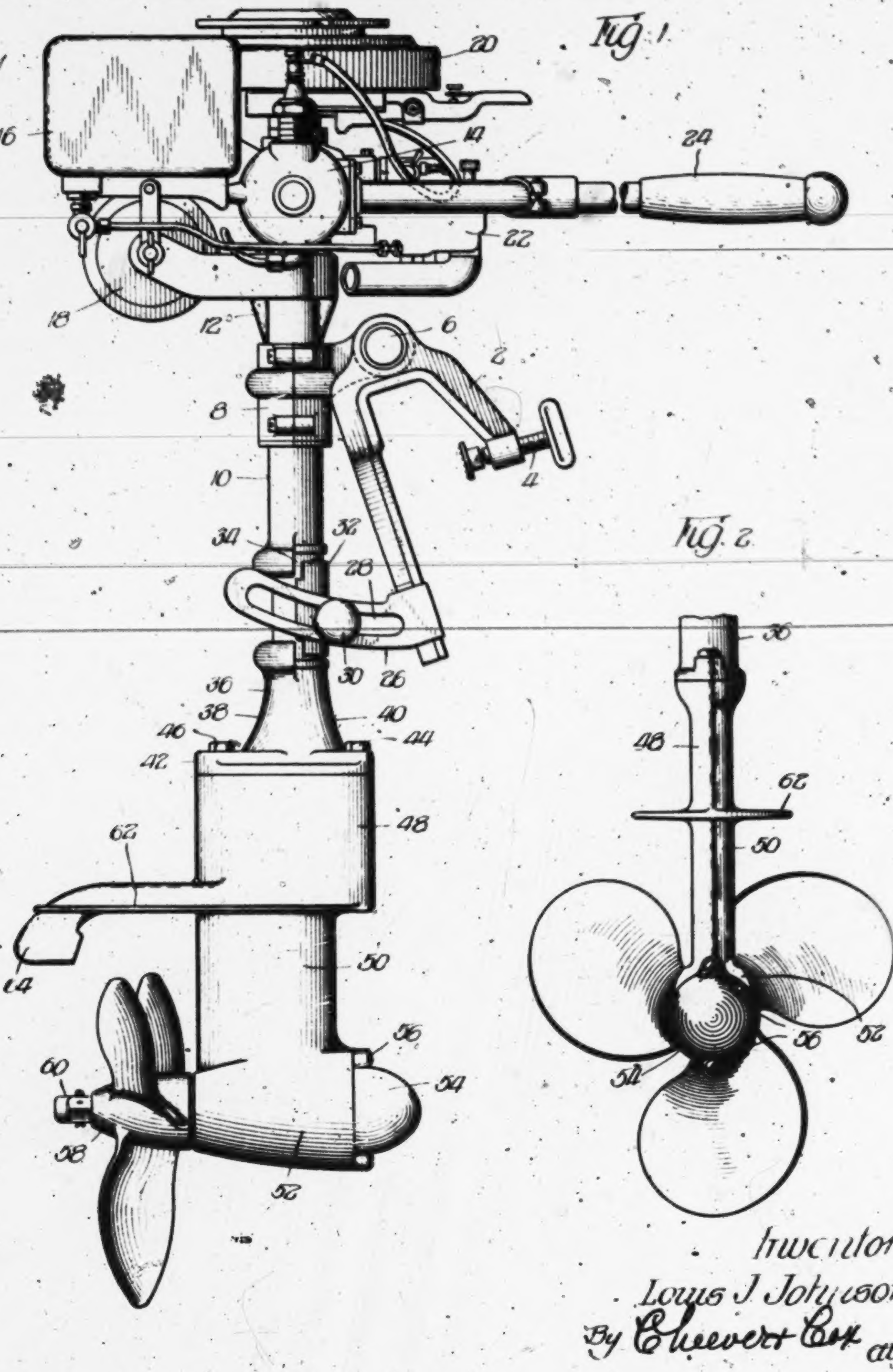
June 17, 1930. L. J. JOHNSON 1,763,970

STREAM LINE CONSTRUCTION

Filed June 18, 1928 2 Sheets-Sheet 1



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348,

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STREAM LINE CONSTRUCTION

Filed June 18, 1928 2 Sheets-Sheet 2

Fig. 3

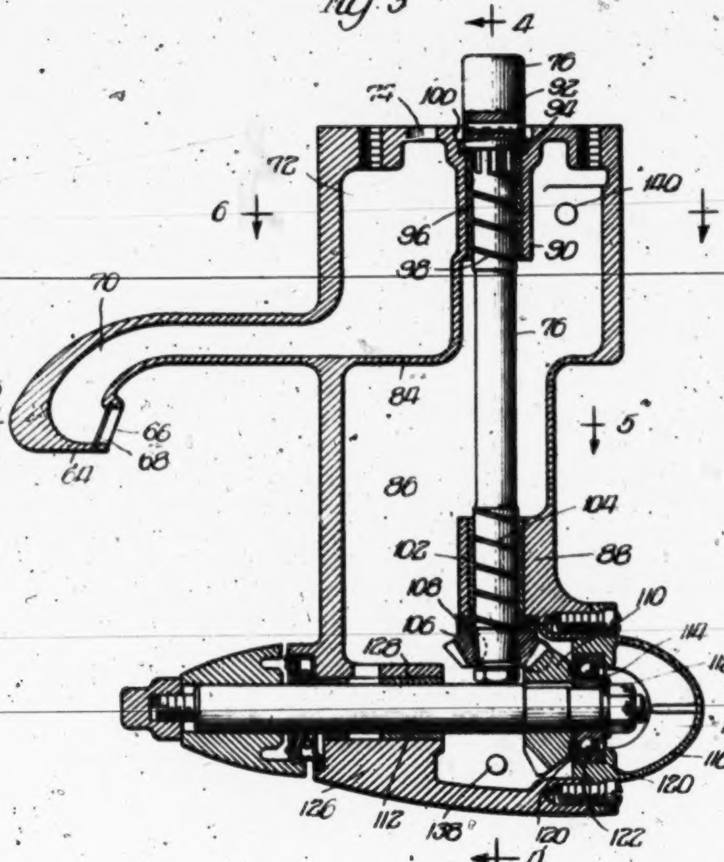


Fig. 4

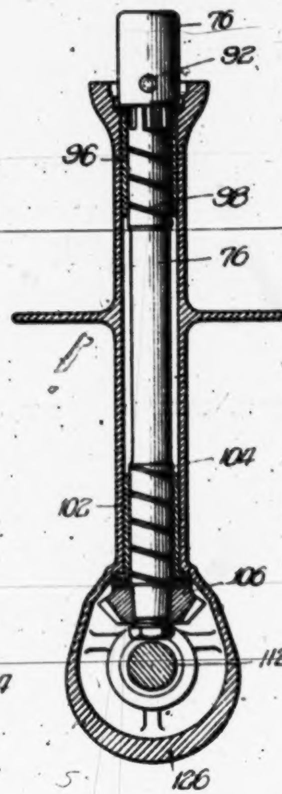


Fig. 5

Fig. 6

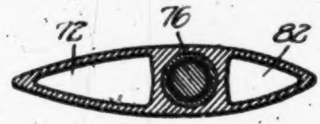
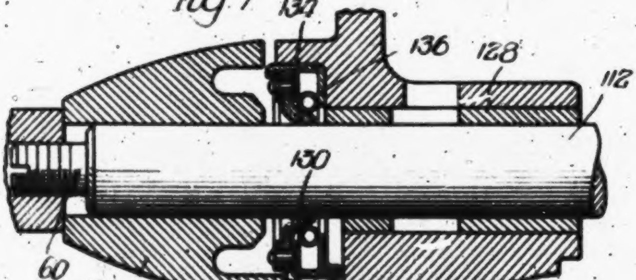


Fig. 7



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UNITED STATES PATENT OFFICE

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STREAM-LINE CONSTRUCTION

Application filed June 18, 1928. Serial No. 286,223.

My invention relates to stream line constructions for the casing which encloses the lower unit of an outboard or inboard motor assembly.

The present construction relates to certain improvements in the stream line construction shown in an application filed jointly by me and Harry L. Johnson on January 16, 1928, Serial No. 247,004, relating to the stream line contour of the lower unit of an outboard or inboard type of motor and in which prior application the lower unit comprised an enclosing casing in which were housed the vertical drive shaft, the angularly disposed propeller shaft carrying the propeller, and wherein also there was provided an anti-cavitation plate which in conjunction with the casing and a water inlet and discharge, provided means in conjunction with the propeller for forcing water through the internal passages in the gear casing and upwardly to the water jacket of the engine. In this prior construction this gear casing was formed of stream line contour to a point above the normal water level whereby to permit the lower propeller carrying structure or unit to move through the water with little resistance.

In the present invention I have provided an improved stream line construction for this lower unit which new construction provides a minimum resistance to the water during the travel of the boat. In this improved construction the lower portion of the housing or casing, or that portion which is wholly submerged in the water, is formed with a stream line contour wherein the front vertically extending portion thereof is designated as a rounded blunt-like nose and trails rearwardly into a substantially knife-like edge, while the upper portion of the casing or that portion which lies slightly under, at, and above the water line and which is adapted to cut the water as the boat travels therethrough, is formed of approximately symmetrically shaped knife-edge contour, that is, the front edge of the casing or that edge which faces the direction of travel of the boat instead of being roundedly blunt as is the case with the corresponding lower portion of the casing is of approximately wedge or knife-edge construction so as to provide a cutting action to the water. This combination of stream line contours of the casing offers the least resistance to the travel of the boat through the water and permits of extremely high speeds.

Certain other features of my invention relate to the bearing members for the approximately vertical drive shaft and the approximately horizontal propeller shaft and also to the manner in which these bearings may be lubricated.

These and other objects of my invention will be apparent from a perusal of the following specification when taken in connection with the accompanying drawings, wherein:

Figure 1 is a side elevation of my improved stream line construction;

Figure 2 is a front view thereof;

Figure 3 is a side sectional view of the lower portion of the structure;

Figure 4 is a section on line 4—4 of Figure 3;

Figure 5 is a section on line 5—5 of Figure 3;

Figure 6 is a section on line 6—6 of Figure 3; and

Figure 7 is a detail sectional view of the sealed bearing for the rear end of the propeller shaft.

Referring now to the drawings in detail, my improved construction is shown for purposes of exemplification as applied to the propeller carrying unit of an outboard motor; the device is equally applicable to any type of inboard motor.

In figure 1 the outboard motor assembly comprises the usual bracket 2 adapted to be attached by means of the clamp 4 to the suitable stern support of a water vehicle. This bracket 2 is provided with a pivotal shaft 6 on which is mounted the usual supporting collar 8 and tubular casing 10. The upper end of this support and casing is provided with a cylinder block 12 on which is detachably mounted the self contained power plant or prime mover for driving the propeller. As in the usual type of outboard motor this

power plant comprises a two-cycle double opposed gas engine, one of the cylinders of which is shown at 14. In addition the fuel tank 16, muffler 18, the combined flywheel magneto and rope starter 20, the carbureter 22, the tiller control 24 and other adjunctive devices are all carried by the cylinder block. In the present type of construction the tiller control 24 and the entire prime mover turn with the tubular casing 10 but other arrangements are within the contemplation of this invention such for instance as turning the tubular casing 10 by means of the tiller control 24 without turning the engine or prime mover and its adjunctive parts.

The lower-most portion of the bracket 2 is provided with laterally curved spaced apart arms 26 slotted as at 28 to receive a clamping screw 30 which in turn carries a portion of a collar 32 having locking portions adapted to make locking engagement with corresponding locking portions 34 on the lower portion of the casing 10 so that when the propeller carrying casing is shifted into reversing position the casing will not be permitted to tilt. All of the foregoing construction is old in the art and no specific claims are made thereto.

The particular features forming the subject matter of the present invention relate to the construction of the propeller carrying casing adapted to enclose the lower-most part of the engine drive shaft which passes downwardly substantially vertically and within the tubular casing 10 and which gear casing also houses the propeller carrying shaft and carries the propeller and in addition is preferably provided with internal water passages and means for causing the circulation of the water upwardly through the casing to the water jacket of the engine. One of the features of my present invention resides in the particular stream line conformation of this casing whereby minimum resistance through the water is provided so that relatively high speeds may be attained.

In the present construction which is a preferred embodiment of my invention, the lower portion of the tubular casing 10 is provided with an upper housing 36 which flares forwardly and rearwardly as at 38 and 40 towards its bottom and is there provided with a flanged cap 42 which approaches substantial stream line contour. This flanged cap 42 is bolted as at 44 and 46 to the upper portion of the stream line propeller carrying casing 48. This propeller carrying casing is preferably formed as a main casting of light metal such as aluminum or aluminum alloy and is formed with a lower vertical portion 50 which merges into a propeller casing 52 of substantially round dimensions as clearly shown in Figures 2 and 4. The front or nose of this propeller casing 52 is closed by means of a cap 54 bolted thereto as at 56 while the rear of the casing is substantially closed by means of an appropriate packing hereinafter described and the propeller 58 and the nut 60. Located below the normal water level when the assembly is mounted on the boat in operative position, the casing 48 and 50 is provided with an integral anti-cavitation plate 62 adapted to directly overlie the path of travel of the propeller blades. In my preferred embodiment this anti-cavitation plate is utilized as a means for carrying a water gathering mouth 64 integral therewith which water gathering mouth is provided with an opening 66 having a grating 68 or screen for obstructing sticks and other floating objects and preventing them entering the water circulating system. As shown clearly in Figure 3, this anti-cavitation plate is formed hollow so as to provide a water conduit 70 which communicates with a water inlet passage 72 in the upper portion of the casing 48 which passage in turn communicates by means of an outlet 74 with a water inlet pipe, not shown, passing upwardly through the circuit casing 10 about the vertical drive shaft of the engine which forms an extension of the lower shaft 76 enclosed by the gear casing and which is detachably clutched thereto as is well known in the art.

In the prior application before mentioned, the entire gear casing above described was formed of stream line contour of substantially knife-edge construction and wherein it was formed from top to bottom of the cross section substantially shown in Figure 6 of the present drawings, that is, of symmetrical wedge-shaped construction. In my present invention I have formed the lower portion of the casing or that portion 50 which extends up to the anti-cavitation plate 62, of stream line design or contour different from the upper portion 48. This lower portion of the gear casing 50 is that portion which is constantly submerged and therefore in order to present the minimum resistance to the flow of water, the vertical front edge or nose of this portion of the casing 50 is formed of the stream line design shown in Figure 5, the same being of substantially blunt or rounded formation as is indicated at 78, the contour thence being formed of smoothly flowing symmetrical walls terminating in a trailing knife-edge design portion 80. As distinguished from this particular shape the upper portion 48 from the horizontal plane of the anti-cavitation plate 62 to the top of the casing 48 is formed of the cross section substantially indicated at Figure 6 wherein the front edge or nose of this section 48 of the casing is formed of substantially wedge-shaped or knife-edge shape as shown at 82. The particular formation of this frontal edge of this upper portion in the manner described permits this portion which lies substantially at, and above the normal water line, to cut

or divide the water and spray during the passage of the casing unit through the water, hence permitting higher speeds than if the entire casing were of the stream line construction shown in Figure 5 and vice versa, the stream line construction of the lower portion 50 of the casing permits of higher speeds than if the entire casing were of the stream line construction shown in Figure 6. Hence by means of this combination of stream line constructions, much higher speeds in traveling through the water are permitted.

The internal construction of the lower unit or propeller carrying casing is substantially shown in Figures 3 and 4 of the drawings. This casing is provided with an internal partition 84 which forms the upper water passage 72 and provides a lubricant containing chamber 86. In addition, the lower portion of this chamber is provided with an integral bearing 88 while the upper portion is provided with a bearing 90, both for the vertical drive shaft 76 which forms a continuation of the engine shaft.

This vertical drive shaft has pinned thereto as at 92 a clutch collar 77 and the lower edge of this collar 77 provides a means whereby the shaft can hang upon a seat formed by means of a washer 94 seating on an upper shoulder of the bearing 90 and upon a bushing 96 surrounding a large portion of the vertical shaft 76. In addition, this shaft is provided at its upper end with a spiral oil groove feed 98 which is adapted to receive oil from a circular recess 100 in the upper portion of the casing 48 which bore or cup 100 is fed with a lubricant which leaks downwardly from the upper crank casing and this lubricant in turn is fed by means of the spiral groove 98 into this bearing. In like manner, the lower bearing 88 is provided with a bushing 102 and the drive shaft 76 is provided with an additional spiral groove 104 for feeding lubricant within the chamber 86 of the casing to the bearing at this point. The lower portion of the drive shaft 76 below this bearing has splined thereto a bevel gear 106 spaced from the bushing 102 and the bearing 88 by means of a washer 108 which faces a circular flange on the bottom portion of the bearing 102. This gear 106 meshes with another bevel gear 110 mounted on the propeller carrying shaft 112 which is arranged substantially at right angles to the shaft 76 and is mounted on a ball bearing 114 carried in the closing cap 116 which as heretofore stated is provided with a bluntly circular dome which closes the front of the propeller carrying portion of the casing 52. Within this cap 116, a nut 118 securely holds the inner-most portion of the bearing 114 on the shaft. The outer ring of the ball bearing or that designated at 120 is provided with an inwardly extending ring 122, the inner circumferential edge of which is slightly spaced from the outer periphery of the inner seal of the ball bearing member 114 so as to prevent the water or any leakage from within the chamber 86 from passing into the front chamber 124 within the dome 116. In addition by means of the rotation of the gear 110 the circumferential effect will throw the water or other leakage outwardly and thus prevent it entering past the ball bearing 114 and into the chamber 124. This chamber is completely filled with lubricant and thus a self contained lubricating system is attained by means of this bearing construction. The lower portion of the casing 52 is provided with an additional bearing 126 having a bushing 128 in which the propeller 112 fits. The rear end of this casing 52 is provided with an opening through which the propeller shaft projects and this opening is sealed by means of a flexible washer 130 preferably of leather, carried by a sheet metal ring 132 in an enclosing or outer ring 134, a coil spring 136 forcing the leather gasket 130 normally against the shaft whereby to provide a friction seal which prevents water passing in from the rear of casing 52 and likewise prevents a lubricant passing out. The hub of the propeller 58 surrounds the outer end of the shaft, being suitably attached thereto and is held in place on the threaded end of the shaft by means of the nut 60.

Lubricant may be fed into the chamber 86 of the lower casing through means of an inlet 138 and a lubricant outlet 140, the former being located substantially at the lowermost part of the propeller casing 52 and the latter being located substantially at the top as shown in Figure 3. These holes 138 and 140 are closed by suitable threaded plugs, the outer surfaces of which form with the casing the proper stream line contour. Water which accumulates in chamber 86 may be withdrawn from the bottom opening 138.

It will thus be seen that I have provided a most improved construction for the lower unit or propeller carrying casing of an outboard or inboard motor assembly.

In general, it is constructed of stream line contour of such design as to present a minimum resistance to the water, particularly at high speeds, and in addition is constructed so as to provide a most economical, efficient, and convenient assembly of bearing construction for the substantially vertical drive shaft and the substantially horizontal propeller shaft while at the same time thoroughly lubricating these shafts and their bearings and preventing the leakage into the casing of any water from the outside and also preventing the egress or leakage of lubricant from within the casing.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. A propulsion device for water vehicles

comprising in combination, a support, a prime mover mounted thereon and having a substantially vertical drive shaft, a casing surrounding said drive shaft, a propeller carrying unit mounted on the lower end of said casing and enclosing said drive shaft, a propeller shaft within said casing and geared to said drive shaft, a propeller on said propeller shaft, said casing being of stream line contour from its lower-most point to above the normal water level, that portion of the casing below the water level having a frontal edge of rounded blunt-like stream line contour and that portion of the casing at and above the normal water level having a frontal edge of substantially wedge-shaped or knife-edge construction.

2. A propeller carrying casing for a water propulsion device and having its upper portion adapted to project above the normal water level, said casing being of stream line contour from top to bottom, that portion of the casing which lies at and above the normal water level being of symmetrical knife-edge construction of stream line contour and that portion below the normal water level having its frontal edge of bluntly rounded stream line contour with a trailing edge of substantially knife-edge stream line construction.

3. A propeller carrying casing for a propulsion device of a water vehicle having an anti-cavitation plate directly overlying the path of travel of the propeller blades, and lying below the water level, said casing having a portion projecting above the water level of substantially symmetrical knife-edge or wedge-like stream line contour and having a portion below said anti-cavitation plate, the front vertical edge of which is of substantially bluntly rounded stream line contour and the trailing edge of which is substantially knife-edge or wedge-like stream line contour.

4. A propeller carrying casing for a water propulsion device of a water vehicle comprising an integral casing having an upper portion adapted to lie substantially at and above the normal water level, and being of symmetrical substantially knife-edge construction of stream line contour, and having a lower portion of stream line contour wherein the front vertical edge is of substantially rounded blunt-like stream line contour and trails rearwardly into a substantially knife edge stream line contour.

5. A propeller carrying casing for a propulsion device for a water vehicle comprising an integral casing carrying a vertical drive shaft, a propeller shaft and a propeller, said casing having an integral anti-cavitation plate extending rearwardly and overlying the propeller, said casing from the anti-cavitation plate upwardly being of symmetrical substantially knife-edge construction stream line contour and said casing from the anti-cavitation plate downwardly having a frontal vertical edge of substantially rounded stream line contour trailing into a substantially knife-edge stream line contour.

6. A propeller carrying casing for the propulsion unit of a water vehicle comprising a casing having an integral anti-cavitation plate extending rearwardly to overlie the path of travel of the propeller and provided with a water gathering mouth adapted to have water forced thereinto by the travel of the propeller blades, said anti-cavitation plate being formed with a hollow passage connecting with an internal passage within the casing, said casing having a discharge outlet adapted to connect with the water jacket of the prime mover of the propulsion device, said casing at and above the anti-cavitation plate being of substantially symmetrical knife-edge stream line construction, said casing below the anti-cavitation plate having frontal vertical edge of substantially bluntly rounded stream line contour trailing into a knife-edge stream line contour.

7. The combination with a propulsion device for a water vehicle, a prime mover having a vertically extending drive shaft, a gear casing adapted to carry the propeller, said gear casing having an upper bearing for said drive shaft and a spaced lower bearing for said drive shaft, a propeller carrying shaft disposed at right angles to said drive shaft and having bearings in the lower portion of said casing, bevel gears interconnecting said shafts, a bushing for the upper bearing, means at the upper portion of said bushing forming a lubricant containing recess, said drive shaft within said bushing being provided with a spiral groove adapted to receive lubricant from said recess, said drive shaft at said lower bearing having a spiral groove for feeding lubricant contained within said casing to said lower bearing.

8. In a water propulsion device for a water vehicle, the combination with a support, a prime mover thereon having a vertically depending drive shaft, a propeller carrying casing mounted on said support and adapted to house the lower end of said drive shaft, a horizontal propeller shaft mounted in the lower portion of said casing and carrying a bevel gear meshing with a bevel gear on the lower end of said vertical drive shaft, a ball bearing for the frontal end of said propeller shaft, a cap closing the front of said casing and closing the front end of said propeller shaft and adapted to contain lubricant therein, the outer annular race of said ball bearing having an annular inwardly projecting ring carried thereby and spaced from the peripheral wall of the inner annular race of said ball bearing, said ring being spaced adjacent the bevel gear mounted on said horizontal shaft whereby the said bevel gear in its rotation will tend to keep water or other leakage

away from said ball bearing and its ring and prevent leakage of said water into said cap.

9. In a water propulsion device of the outboard motor type, the combination of a prime mover provided with a depending drive shaft, a propeller carrying casing adapted to house the lower end of said drive shaft, a horizontal shaft mounted within said casing and geared to the lower end of said drive shaft, said casing having a rear opening through which said propeller projects, a propeller on the projecting rear end of said shaft and a sealed packing carried by said casing and shaft for said opening through which the propeller shaft projects, said packing comprising a flexible annular gasket adapted to frictionally drag about the periphery of said propeller shaft and a resilient means directly engaging and pressing said flexible gasket against said shaft whereby to prevent the ingress of water into said casing and the egress of lubricant out of said casing through said opening.

10. In a water propulsion device for the prime mover of a water vehicle comprising the combination of a prime mover having a vertically depending drive shaft, a support concentrically surrounding said drive shaft and having a gear casing at its lower end surrounding said drive shaft and enclosing the same, a propeller carrying casing geared to said drive shaft and passing through the rear end of said casing, a propeller thereon, said casing being provided with an internal lubricant containing chamber extending substantially the height of said casing, said casing having a lower opening and being provided with an upper opening, plugs closing said openings, said openings being adapted to the insertion of lubricant and the withdrawal of water from said chamber.

11. A propeller carrying casing for the lower unit of a propulsion device of an outboard motor type, said casing being an integral construction of relatively light metal and provided with an integral anti-cavitation plate formed with an internal water passage, said casing at and above said anti-cavitation plate being of substantially symmetrical wedge-shaped stream line contour, and said casing below said anti-cavitation plate having a frontal edge of substantially rounded bluntlike stream line contour trailing into a substantially knife-edge stream line contour, said anti-cavitation plate having a lower portion over-hanging the path of travel of the propeller blades and provided with a water gathering mouth lying in the rear of the path of travel of the propeller blades, said depending portion and water gathering mouth being of less width than the width of the stream line contour at such horizontal plane of the casing.

12. A propeller carrying casing for the lower unit of an outboard motor propulsion device having an integrally formed anti-cavitation plate, and the casing having a stream line contour with its front vertical edge of comparatively blunt-like stream line contour trailing rearwardly to a substantially knife edge stream line contour.

13. A propeller carrying casing for a water propulsion device having an integrally formed anti-cavitation plate, and the casing having a stream line contour with a knife edge both at the front and rear edges of the casing.

14. A propeller carrying casing for a water propulsion device having its upper portion adapted to project above the normal water level, said casing being of stream line contour from top to bottom; and that portion below the normal water level having its front edge of bluntly rounded stream line contour with a trailing edge of substantially knife edge stream line construction.

15. A propeller carrying casing for a propulsion device of an outboard motor having an anti-cavitation plate overlying the path of travel of the propeller blades and having a water gathering mouth below the plate adapted to receive water forced there into by the propeller blades, and said casing being of stream line contour having a front vertical edge bluntly rounded and a trailing rear edge of thin stream line contour substantially less in width than the gathering mouth and located at a distance in front of the gathering mouth.

16. A propeller carrying casing for the lower unit of a propulsion device of an outboard motor type, having an integrally formed anti-cavitation plate, and the casing having a stream line contour above and below the anti-cavitation plate, the front edge of the casing on one side of the plate being in advance of the front edge on the other side of the plate.

17. The combination with a propulsion device for a water vehicle of a prime mover having a vertically extending drive shaft, a gear casing adapted to carry the propeller, said gear casing having a bearing for said drive shaft and a recess at the upper end of the bearing for receiving lubricant, and said drive shaft within said bearing having groove for feeding lubricant to the bearing from said recess.

18. A propulsion device for a water vehicle comprising a prime mover having a vertically extending drive shaft, a gear casing adapted to carry the propeller said gear casing having a lubricant chamber and a shaft bearing therein and said drive shaft within the bearing having a groove communicating with the chamber for feeding lubricant contained within the casing chamber to said bearing.

19. A propeller carrying casing for a water propulsion device having an integrally formed anti-cavitation plate, and the casing

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having a stream line contour with a knife edge both at the front and rear edges of the casing, the casing on one side of the plate being longer from its front to its rear edges than the portion on the other side of the plate.

20. A propeller carrying casing for a water propulsion device having its upper portion adapted to project above the normal water level, said casing being of stream line contour from top to bottom; and that portion below the normal water level having its front edge of bluntly rounded stream line contour with a trailing edge of substantially knife-edge stream line construction and being less in its dimensions from its front to its rear edge than the portion at and above water level.

21. A propeller carrying casing for a water propulsion device having its upper portion adapted to project above the normal water level, said casing being of stream line contour from top to bottom; that portion of the front edge of the casing at and above the water line being of sharp-edged stream line contour and that portion below the normal water level having its front edge of bluntly rounded stream line contour with the trailing edge of substantially knife-edge stream line construction, the casing at and above the water line being longer from its front to its rear edges than that portion below the normal water level.

In witness whereof, I have hereunto subscribed my name.

LOUIS JAMES JOHNSON.

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Jan. 12, 1937. H. L. JOHNSON 2,067,533

SPARK PLUG COVER

Filed March 25, 1935

Fig. 1.

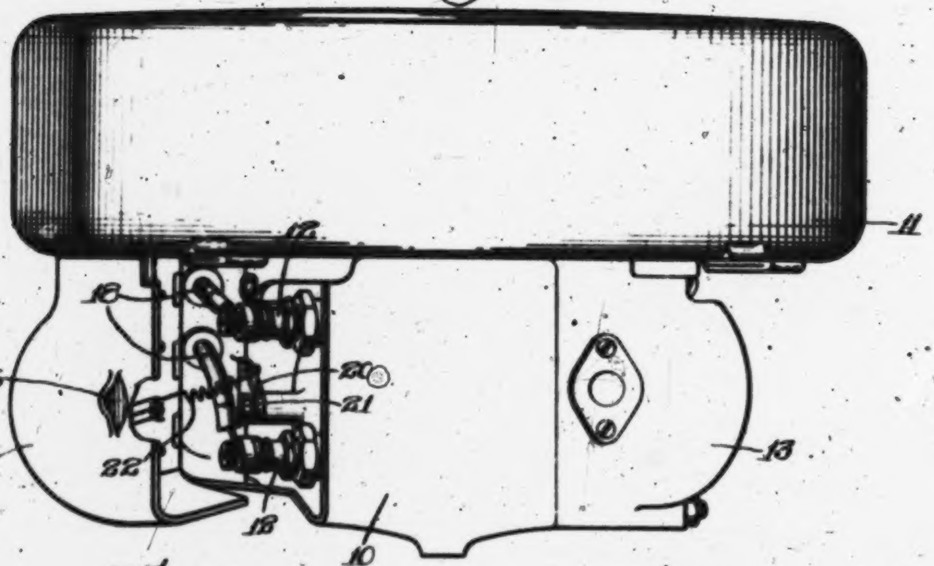


Fig. 2.

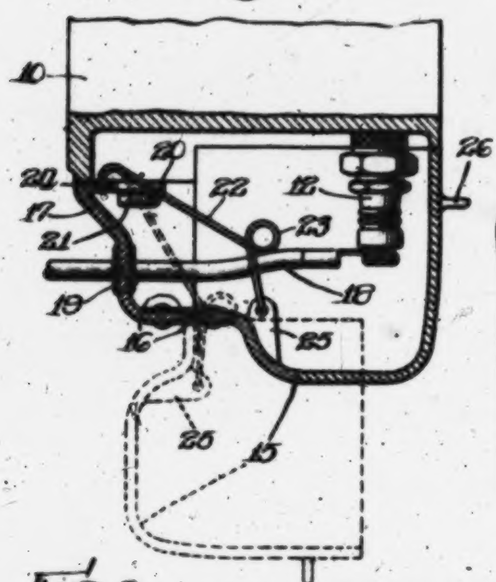


Fig. 3.

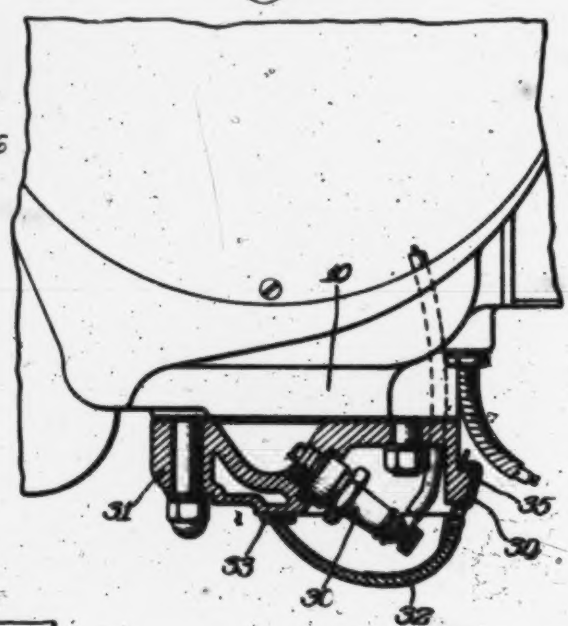
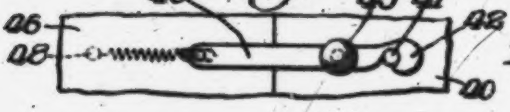


Fig. 4.

Fig. 5.



Inventor:
Harry L. Johnson
By Kent W. Wonnell
Atty.

UNITED STATES PATENT OFFICE

2,067,533

SPARK PLUG COVER

Harry L. Johnson, Waukegan, Ill., assignor to Johnson Brothers Engineering Corporation, Waukegan, Ill., a corporation of Indiana

Application March 25, 1935, Serial No. 12,997

10 Claims. (Cl. 123—143)

This invention relates in general to a spark plug cover for internal combustion engines and has more particular reference to such a cover as used in connection with outboard motor engines or other marine engines where it is important to protect the spark plugs and their electrical connections from water, weather, and other outside conductors.

An important object of the invention is in the provision of a lid or protector which extends over a spark plug or spark plugs which usually project from an internal combustion engine, for the purpose of protecting them.

A further object of the invention is in the provision of means for yieldingly closing the covers and maintaining them in closed position.

A further object of the invention is in the provision of an improved latch or holding means for keeping a cover of this kind in closed position.

A still further object of the invention is in the provision of a cover for the wiring, spark plugs and electrical connections of an internal combustion engine to provide a smooth outer casing without objectionable projections, and providing a stream-line or smooth outer appearance which will minimize resistance to passage through the air and also may be shaped to provide a pleasing outer contour.

In the accompanying drawing illustrating preferred embodiments of the invention,

Fig. 1 is a view in elevation of the power head of an internal combustion engine as used in outboard motors with a protecting cover in accordance with this invention, in partially open position;

Fig. 2 is a sectional view of a casing;

Fig. 3 is a view partly in section of a modification;

Fig. 4 is a section and

Fig. 5 is a view in elevation of a spring pressed latch for a cover of this kind.

In operating certain types of internal combustion engines, particularly those used in connection with outboard motors, it is desirable not only that the spark plugs and connections be protected from the water, but also that for high speed operation the casing shall present a smooth outer appearance and contour which has a minimum air resistance. It is also desirable to cover or protect these parts so that the spark plugs are not easily short-circuited, and on the other hand that they are not exposed so that the hands of an operator will come in contact with them during operation to protect the operator from burning and from electrical shock.

Referring now more particularly to the drawing, a portion of an outboard motor power head is shown in Fig. 1 having an engine bloc or casting 10 with an overlying fuel tank 11, and with spark plugs 12 projecting from one side of the bloc 10. At the other side of the bloc 10 is a muffler 13 and it is desirable, in order to present a smooth and balanced appearance, to have the spark plugs and connections enclosed or covered in a manner to resemble the muffler.

It is also found in outboard motor operation, and more particularly when such motors are used for racing, that water lodging upon the spark plugs or connections, or coming in contact with them, may cause misfiring and consequent lack of power, and in some cases may even interfere with the steering and running of the engine at slow speed. For these reasons a casing or cover 15 is provided which is connected by a hinge 16 with a casing part 17 fixed to the engine head or the bloc 10 by means of a projection 20 and a bolt 21 in such a way that when the cover 15 is closed it will extend over and entirely protect and cover one or more of the spark plugs 12 and any connections or conductors 18 therefor. These conductors are led out through openings surrounded by gaskets 19 in the fixed portion 17 of the casing so that they will not interfere with the opening or closing movement of the cover 15.

In order to hold the cover yieldingly in open and in closed position a spring 22 having a coil 23 intermediate its ends is connected at one end to an opening 24 in the projection 20 and at the other end to a projection 25 at the inner side of the cover 15 adjacent the hinge 16 thereof so that when the cover is open as shown in the broken outline in Fig. 2, the ends of this spring will be on the side of the hinge 16 tending to hold it in open position. When the cover is moved so that the outer end of the spring in the projection 25 is moved beyond the center line including the hinge, the spring will tend to close the cover and hold it in closed position. An outer projection 26 may be provided to facilitate opening and closing the cover if desired.

In the form shown by Fig. 3, a spark plug 30 is shown extending into a removable engine head 31 at an angle thereto so that a shallow cover 32 is connected by a hinge 33 directly to the head 31 and has a latch 34 engaging a projection 35 at the side of the head for holding the cover yieldingly in closed position.

Instead of a latch as shown in Fig. 3 or a spring

as shown in Fig. 2 a separate spring latch as shown in Figs. 4 and 5 may be used. In this case the engine head or bloc 40 has a projection 41 engaged by a hook 42 at one end of a latch 43, the other end of which has a projection 44 extending through a slot 45 in a cover 46 and this projection 44 being connected by a spring 47 to a projection 48 inside of the cover. Intermediate the ends this latch has a knob 49 for moving the hooked end into and out of engagement with the projection 41 and the latch being drawn tight by the sliding movement of the projection 44 in the slot 45 of the cover.

With covers of this kind the spark plugs and electrical connections are protected and may conform to any desired shape or outline, thus improving the appearance of the entire motor or engine and minimizing resistance to its passage through the air.

I claim:

1. An internal combustion engine having an exposed spark plug, and a normally closed cover therefor hinged to the engine for making a tight connection with its outer surface and movable to cover and uncover the spark plug.

2. The combination of an internal combustion engine having a projecting spark plug and connections thereto and a hinged normally closed cover therefor hinged to the engine for closing tightly against its outer surface and movable to cover and to uncover the spark plug and connections.

3. In combination, an internal combustion engine having an exposed spark plug, a cover hinged to the engine to extend over the plug and spring means tending to keep the cover in closed position.

4. The combination with an internal combustion engine having a muffler on one side, a spark plug and its connections on the other side, and a cover for the spark plug and its connections conforming in shape to that of the muffler to present a uniform appearance on both sides.

5. An outboard motor having an internal combustion engine with an exposed spark plug and its connections projecting from the engine, and a spring actuated cover movable to enclose and protect the spark plug and its connections.

6. The combination with an internal combustion engine having exposed spark plugs, of a cover therefor hinged to the engine, and spring means connected to the cover for holding it open and closed.

7. A protector for spark plugs comprising a cover hinged at one side to a fixed support and movable over the spark plug, and a spring extending across the hinge and connected at one end to the cover and at the other end to a fixed support and operative to hold the cover open or closed.

8. An internal combustion engine having an exposed spark plug and connections therefor, an enclosing casing for said exposed parts comprising a part fixed to the engine and through which the connections extend to the outside thereof, a movable part supported by the fixed part and operative to cover and uncover the exposed parts, and a spring connected to the fixed and movable parts for holding the movable part in either of its two limiting positions.

9. A structure in accordance with claim 8 in which the movable casing part is hinged to the fixed part, and the spring is connected at its ends to the fixed and movable parts and extends transversely of the hinge so that the end connected to the movable part is at opposite sides of a line through the hinge and the fixed connection, to hold the movable part yieldingly in open and in closed position.

10. A structure in accordance with claim 8 in which the movable casing part is hinged to the fixed parts, and spring actuated means connecting the parts to retain the movable casing part yieldingly in closed position.

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360

No. 871,459. PATENTED NOV. 19, 1907.

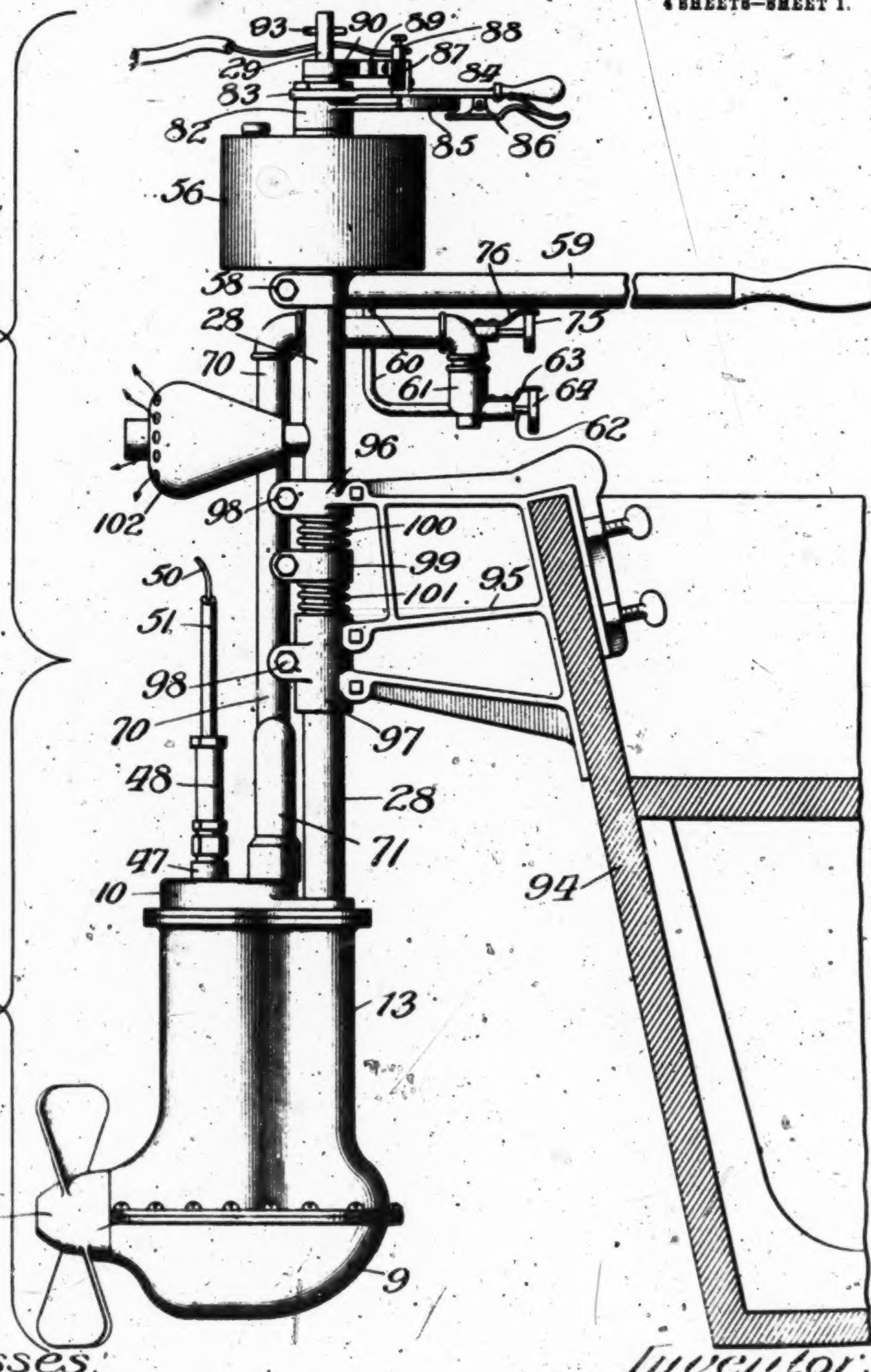
T. THORSEN.

BOAT PROPELLING MECHANISM.

APPLICATION FILED MAR. 1, 1907.

4 SHEETS—SHEET 1.

Fig. 1.



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Att'ys.

362

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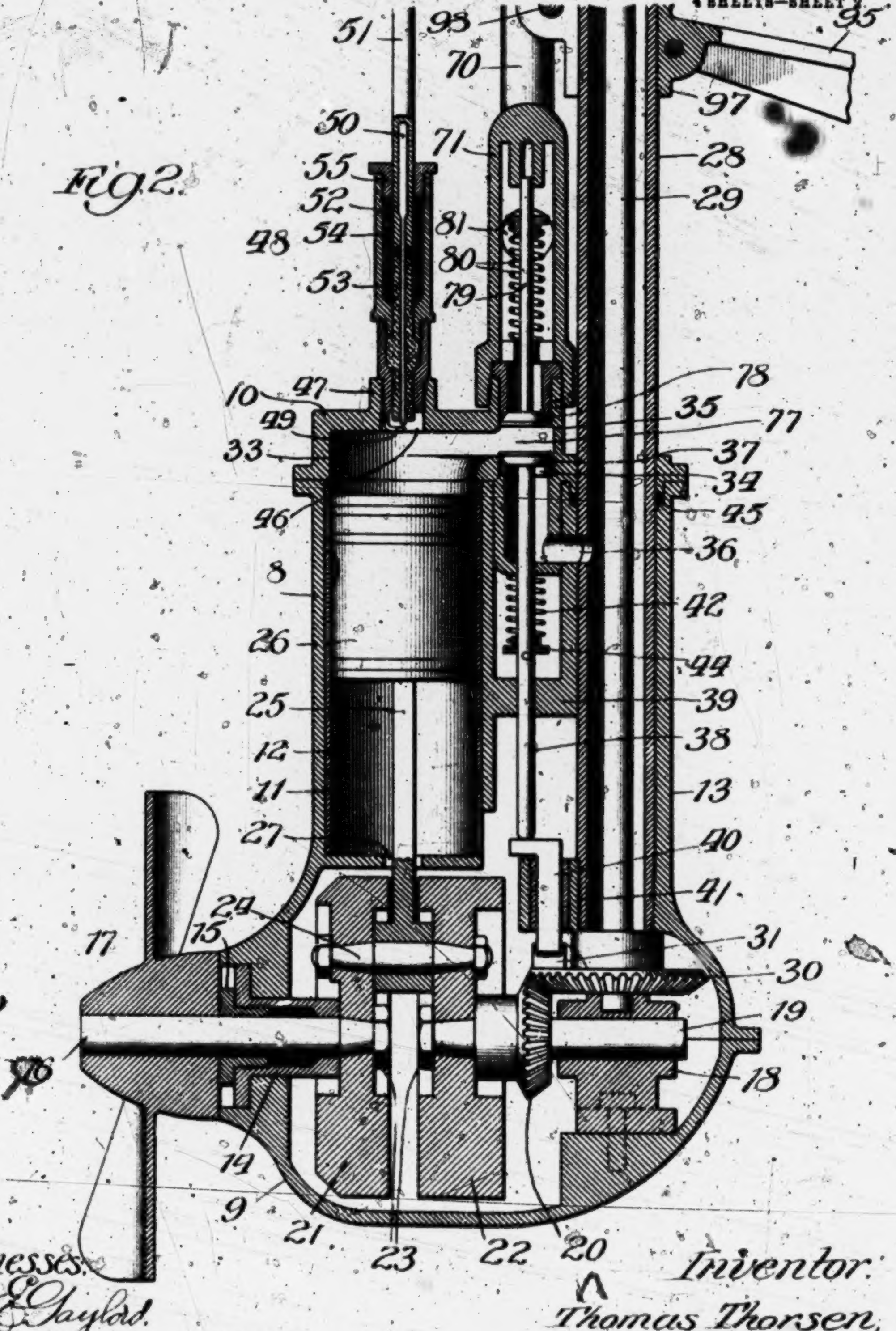
4 SHEETS—SHEET 2.

Fig. 2.



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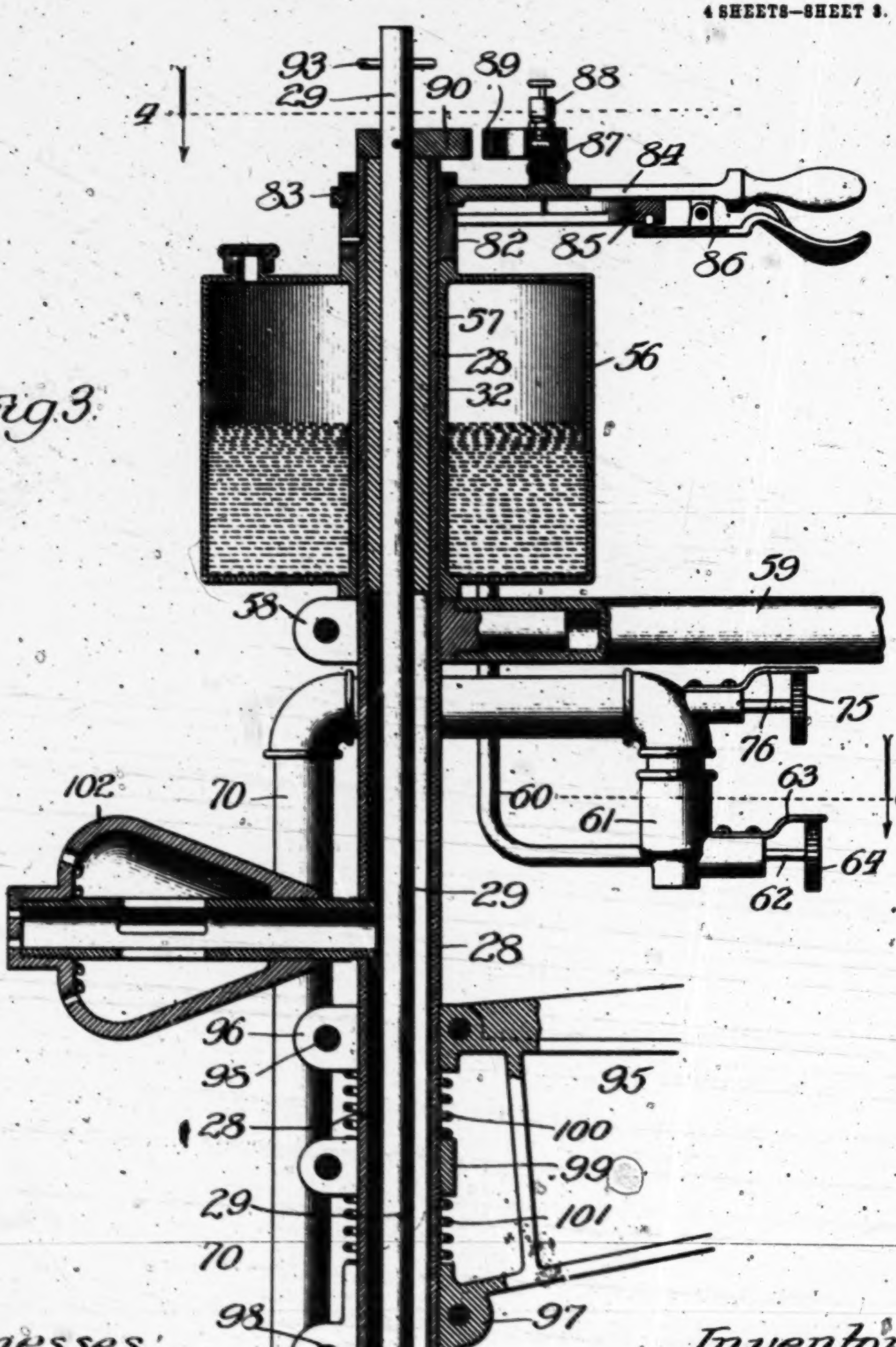
4 SHEETS—SHEET 3.

Fig. 3.



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No. 871,459.

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T. THORSEN.

BOAT PROPELLING MECHANISM.

APPLICATION FILED MAR. 1, 1907.

4 SHEETS—SHEET 4.

Fig. 4.

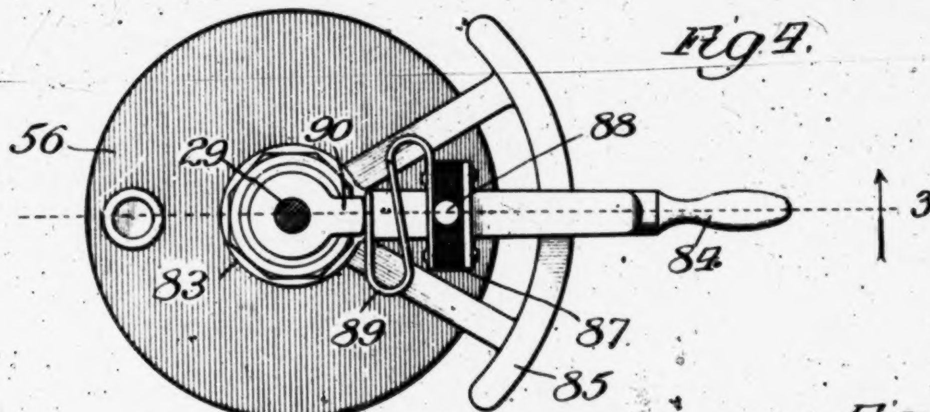


Fig. 6.

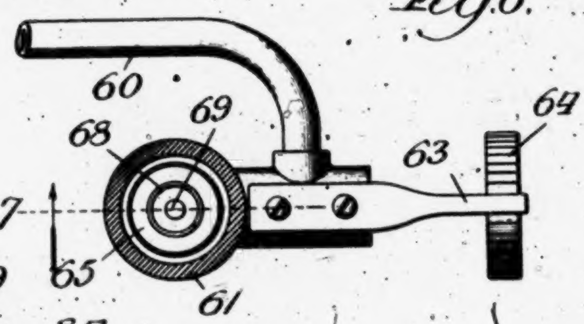


Fig. 5.

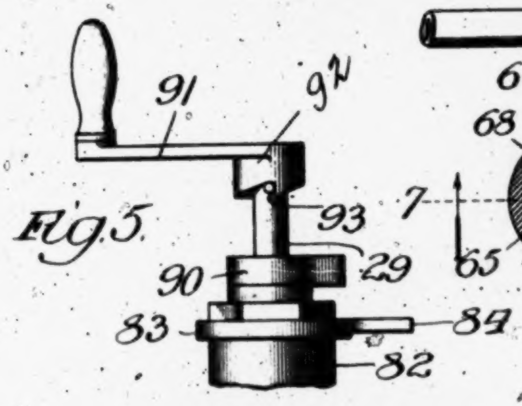
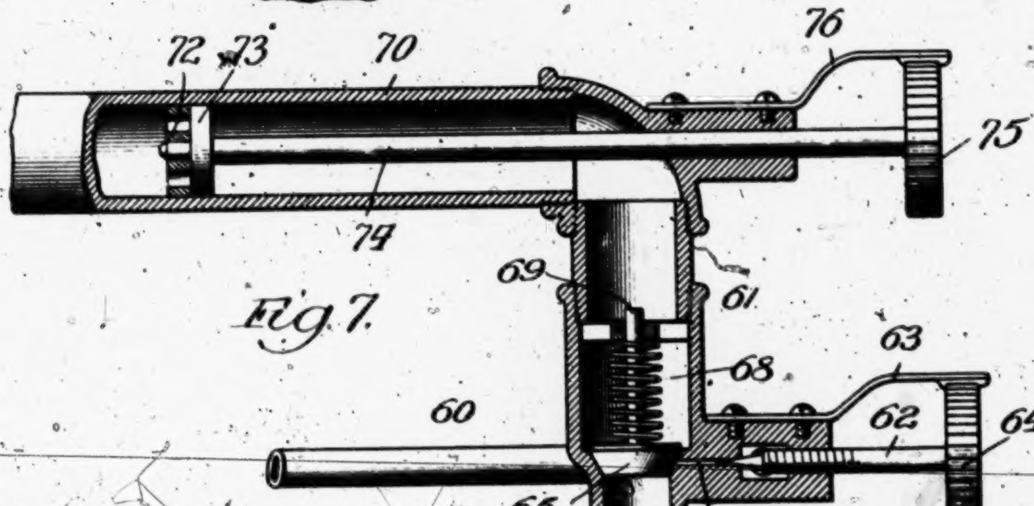


Fig. 7.



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UNITED STATES PATENT OFFICE.

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BOAT-PROPELLING MECHANISM.

No. 871,459. Specification of Letters Patent. Patented Nov. 19, 1907.

Application filed March 1, 1907. Serial No. 360,113.

To all whom it may concern:

Be it known that I, THOMAS THORSEN, a citizen of the United States, residing at Menomonie, in the county of Dunn and State of Wisconsin, have invented a new and useful Boat-Propelling Mechanism, of which the following is a specification.

The object of my invention is to provide a novel and improved construction, in matters of detail, of a combined gas-engine and boat-propeller in a light and compact structure adapted for ready application to and removal from the stern-board of a boat to operate, when in place, as the propelling and steering means therefor.

Referring to the accompanying drawings—Figure 1 shows my improved motor in side elevation removably secured to the stern-board of a boat, of which a broken section is represented; Fig. 2, a view in vertical sectional elevation of the lower part of my improved motor, being the portion thereof embraced by the bracket 2 on Fig. 1; Fig. 3, a similar view of the upper part of my improved motor, being the portion thereof embraced by the bracket 3 on Fig. 1, this view being a continuation of the view presented by Fig. 2 and, like the latter, taken in the plane indicated by the line 3 on Fig. 4 and viewed in the direction of the arrow; Fig. 4, a section taken at the line 4 on Fig. 3 and viewed in the direction of the arrow; Fig. 5, a broken view in elevation showing the starting crank; Fig. 6, a section through the carbureter taken at the line 6 on Fig. 3 and viewed in the direction of the arrow, and Fig. 7, a section taken at the line 7 on Fig. 6 and viewed in the direction of the arrow.

The casing of the engine is a casting, preferably of aluminium for the sake of lightness, consisting of the intermediate body-portion 8, a cap 9 secured on the lower expanded end of the body, and a cap 10 secured on its upper end. The intermediate section 8 contains the cylinder 11 provided with an internal bushing 12, and is also formed, laterally of the cylinder, with a tubular socket 13, shown to be internally threaded at its lower end, for the purpose hereinafter explained. In the junction between the cap 9 and the body 8 is formed a bearing 14, rendered water-tight by a stuffing-box 15, for a rotary shaft 16 carrying on its outer end the propeller 17, the hub of which has close bearing against the casing, as shown. In line with the shaft 16 in the opposite side of the casing, is journaled in a bearing 18, a rotary shaft 19 carrying a vertically disposed bevel-gear 20. The shafts 16 and 19 pass, at their reduced, tapered inner ends, through the centers of fly-wheels 21 and 22, respectively, at the inner sides of which the shafts are secured by nuts 23. A wrist-pin 24 passes eccentrically through the fly-wheels and has journaled upon it the lower end of the rod 25 of the piston 26 in the cylinder 8, in the bottom of which is an opening 27 through which the piston-rod works. A tube 28 is supported in the socket 13, being screwed at its threaded lower end therein, or otherwise rigidly fastened in said socket to adapt it to carry all the parts of the mechanism of the motor and afford a stem through which to support it rotatably, as hereinafter described, upon a boat. A rod 29, for operating the starting and sparking mechanisms, as hereinafter explained, extends through the vertical tube 28 and seats in the bearing 18 rotatably at its lower end, on which it carries the bevel-gear 30 confined by the adjacent end of the tube in engagement with the gear 20 and carrying on its upper face a cam 31. In the upper part of the tube 28 is a bushing 32 in which the rod 29 finds bearing.

The cap 10 forms the explosion chamber 33 having an exhaust-outlet 34 provided in a neck 35 extending downwardly from this cap and containing a discharge-port 36 for the exhaust leading through the socket 13 and tube 28 into the latter. An upwardly opening valve 37 seats in the outlet 34 and has a depending stem 38 passing guidingly through the base of the neck 35 and through a bearing 39 projecting laterally from the cylinder 8 to engage at its lower end with the head of a plunger 40 confined in a bearing 41 in the casing to adapt it to be vertically reciprocated under the action of the cam 31, into the path of which the lower end of the plunger extends. The valve 37 is seated by a spring 42 confined between the base of the neck 35 and a collar 44 on the stem.

At the junction of the cap 10 with the upper end of the socket 13 is a stuffing-box 45, affording a water-tight joint under the pressure of the cap when bolted down in place.

The cap 10 has projecting about an opening 46 in it a nipple 47, into which is screwed the lower end of a sparking-plug 48 carrying

a terminal 49, the other terminal 50 being contained in an insulating tube of soft rubber 51 which extends partway through the plug into the chamber 52 therein, and mica or other insulation 53 surrounds the terminal 50 from a point near which the tubing 51 terminates. The chamber 52 is filled with asphaltum 54, which also enters the space between the insulating media 51 and 53, and is confined by a gland 55 in the upper end of the sparking-plug casing. It is found in practice that the soft rubber tube around the high-tension wire 50, embedded in asphalt 54 in the sparking-plug, affords a perfectly water-tight insulation.

The gasolene for supplying the engine is contained in a supply-tank 56 having a central tubular opening 57 at which it surrounds the stem 28, seating about the lower end of the opening against the head 58 of the tiller 59, at which head the tiller is securely fastened upon the stem. A pipe 60 leads from the base of the gasolene-tank 56 into a carbureter 61 in which a needle-valve 62 works for the usual purpose, being held in adjusted position by a spring 63 bearing against its circumferentially notched hand-wheel 64. A valve 65 in the carbureter seats in the air-inlet opening 66, and when seated closes the gasolene inlet-passage 67 controlled by the needle-valve 62, and is pressed against its seat by a spring 68 surrounding its stem 69. The carbureter communicates with a mixing-tube 70 which leads horizontally, just below the plane of the tiller, and thence downwardly to the mixing-chamber 71, hereinafter described. The horizontal portion of the mixing-tube 70 contains a perforated diaphragm 72, against which works a rotary perforated disk-valve 73, for the usual purpose of controlling the flow through the tube, by regulating the registration of the perforations in the valve with those in the diaphragm. The valve 73 is on a stem 74 provided on its outer end with a circumferentially notched hand-wheel 75, and a spring 76 engages the hand-wheel for holding the valve in adjusted position.

The mixing-chamber 71 seats on the engine-cap 10 over an opening 77 therein directly over the valve 37 and has seated in it a downwardly opening valve 78 on a stem 79 working in guides in the mixing-chamber and having confined about it therein a spring 80 tending to maintain the valve against its seat. The mixing-chamber contains a port 81 with which the lower end of the depending portion of the mixing-tube 70 is connected.

On the upper end of the tubular stem 28 is secured a bearing-collar 82 rotatably surrounded by the annular head 83 of the handle 84 of the device for operating the sparking-plug. This handle is adapted to be turned on a segment 85 supported on arms extending horizontally from the collar 82, to adapt the segment to be engaged, as represented in Fig. 3, by a spring-pressed dog 86 fulcrumed on the handle. Near its inner end the handle 84 is surmounted by an insulated block 87 carrying a binding-post 88 forming one terminal of a sparking-coil (not shown). On this block is fastened a metal contact-spring 89, shown of S-shape, extending at its free end-portion into the path of a contact-finger 90 on the rotary starting-rod 29, whereby when this spring and finger are brought into contact, the course of the current is through the metal casing of the motor to the terminal 49 of the sparking-plug and thence to the terminal 50 which forms the return-wire.

For manually starting the motor the usual form of device shown in Fig. 5 is provided, consisting of a crank-handle 91 applied to the upper end of the rod 29 to engage at its notched head 92 with a pin 93 extending transversely through the rod.

For attaching the motor to the stern-board 94 of a boat, it is provided with a bracket 95, adapted to be removably attached to the stern-board, as clearly represented in Fig. 1. This bracket is provided with upper and lower split collars 96 and 97, to surround the stem 28 near its upper end, being fastened by bolts 98, 98, passed through their projecting ears. The entire motor is sustained yieldingly by the tube 28 on the bracket through the medium of a spring-cushion support, consisting of a collar 99 rigidly but adjustably fastened about the tubular stem and having confined between it and the collar 96, about the stem, a spring 100, and between it and the collar 97, about the tube, a spring 101. This cushioning support for the motor takes up the vibrations of the engine and prevents them from being felt in the boat.

The engine illustrated and described is the four-cycle type. To start it, the crank-handle 91 is manipulated to rotate the starting-rod 29 and through the gearing 30, 20 actuate the piston 26 to draw gas into the chamber 33 by the suction-effect of the downstroke of the piston upon the valve 78, to open the latter. Thus rotating the starting-rod actuates the sparking-plug to ignite the charge in the explosion-chamber while under compression from the piston, all as is usual in this type of engine. The parts are so timed that after each explosion the cam 31 will raise the plunger 40 to lift the valve 37 from its seat and permit the exhaust through the outlet 34 and port 36 into the tube 28, which is equipped, near its upper end, with a muffler 102 of suitable construction, such as that shown in detail in Fig. 3. By thus taking the exhaust through the stem 28 the provision for the exhaust is rendered peculiarly simple and compact. It will also be ob-

served that the throttling of the gas-supply is effected at a point so far away from the mixing-chamber as to enable the mixing-tube to be provided of comparatively great length, with the advantage of insuring thoroughness in the mixture of the charge.

With the motor in operative position on the boat, the engine is submerged in the water and is thus water-jacketed in the most effective manner; and with the supply-tank for gasolene supported on the upper end of the stem 28, it is outside of the boat, so that leakage from it cannot take place into the boat where it would be dangerous, owing to liability of ignition and consequent accident.

The described construction of sparking-plug-controlling mechanism is peculiarly simple and effective for regulating the speed of the engine by positioning the spring 89 with reference to the finger 90, to produce the contact at any desired point in the rotation of the contact-finger, depending on the position to which the spring is brought by turning the handle 84 on the segment 85. Moreover, by providing the cam-carrying rod 29 with the valve-gear connections thereof, the starting mechanism is brought into a position of most ready accessibility for its manipulation.

It will be observed that the manner of supporting the motor in the bracket, through the medium of a stem carrying the motor and rotatably carried by the bracket, permits the motor, when in operative position on a boat, to be turned to any desired angle for steering under the action of the rotating propeller. By this ready steering function of the motor, it serves, as is shown in practice, to turn around, within its own length, a boat as long as thirty feet. Furthermore, it will be apparent that by the described construction, turning the motor a half revolution in the bracket from the position shown, will cause it to propel the boat in the backward direction, thus avoiding any necessity for reversing the engine for the purpose.

What I claim as new, and desire to secure by Letters Patent, is—

1. In combination, a combined submergible gas-engine and boat-propeller, a stem forming the carrying medium therefor, a bracket removably attachable to the stern of a boat and on which said stem is rotatably supported, a cushioning support for the stem on the bracket, and a tiller connected with the stem.

2. In combination, a combined submergible gas-engine and boat-propeller, a stem forming the carrying medium therefor, a bracket removably attachable to the stern of a boat and on which said stem is rotatably supported, and a spring medium supporting said stem on the bracket and forming a vibration-absorbing cushion.

3. In combination, a combined submergible gas-engine and boat-propeller, a stem forming the carrying medium therefor, a bracket removably attachable to the stern of a boat and provided with collars in which said stem is journaled, a collar secured on the stem between said bracket-collars, and springs confined about the stem between the collar secured thereon and said bracket-collars.

4. In combination, a combined submergible gas-engine and boat-propeller, a tubular stem forming the carrying medium therefor, and into which the engine exhausts, a muffler on said stem, and a bracket removably attachable to the stern of a boat and on which said stem is rotatably supported.

5. In combination, a combined submergible gas-engine and boat-propeller having a stem forming the carrying medium therefor, a gasolene-supply tank, an adjustable electrical contact-device supported on said stem for controlling the operation of the sparking-plug of the engine, and a bracket removably attachable to the stern of a boat and on which said stem is rotatably supported.

6. In combination, a combined submergible gas-engine and boat-propeller having a stem forming the carrying medium therefor, a gasolene-supply tank supported on the upper end of said stem, a valved mixing-tube leading from a point adjacent to said tank to the mixing-chamber of the engine, and a bracket removably attachable to the stern of a boat and on which said stem is rotatably supported.

7. In combination, a combined submergible gas-engine and boat-propeller having a tubular stem forming the carrying medium therefor, and by which the motor is adapted to be supported on a boat, with the exhaust from the explosion-chamber of the engine opening into said stem, and a muffler on said stem.

8. In combination, a submergible casing containing a gas-engine and carrying a propeller connected therewith to form a motor, a tubular stem forming the carrying medium for said motor, a starting-rod journaled in said stem and having a gear-connection with the engine, and manually-operated starting mechanism supported on said rod.

9. In combination, a submergible casing containing a gas-engine and carrying a propeller connected therewith to form a motor, a tubular stem forming the carrying medium for said motor, a starting-rod journaled in said stem and having a gear-connection with the engine, and adjustable electrical contact-mechanism for the sparking-plug of the engine, supported on said stem and rod.

10. In combination, a submergible casing containing a gas-engine and carrying a propeller connected therewith to form a motor, a tubular stem forming the carrying medium for said motor, a starting-rod journaled

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in said stem and having a gear-connection with the engine, and electrical contact-mechanism for the sparking-plug of the engine, consisting of a contact-finger secured on said rod near its upper end, a handle rotatably supported on the upper end of said stem and an insulated contact-spring on said handle adapted to be connected in an electric circuit.

THOMAS THORSEN.

In presence of—
JOHN HORWOOD,
C. E. FREEMAN.

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J. G. DUCASSOU.

PROPELLING MECHANISM FOR BOATS.

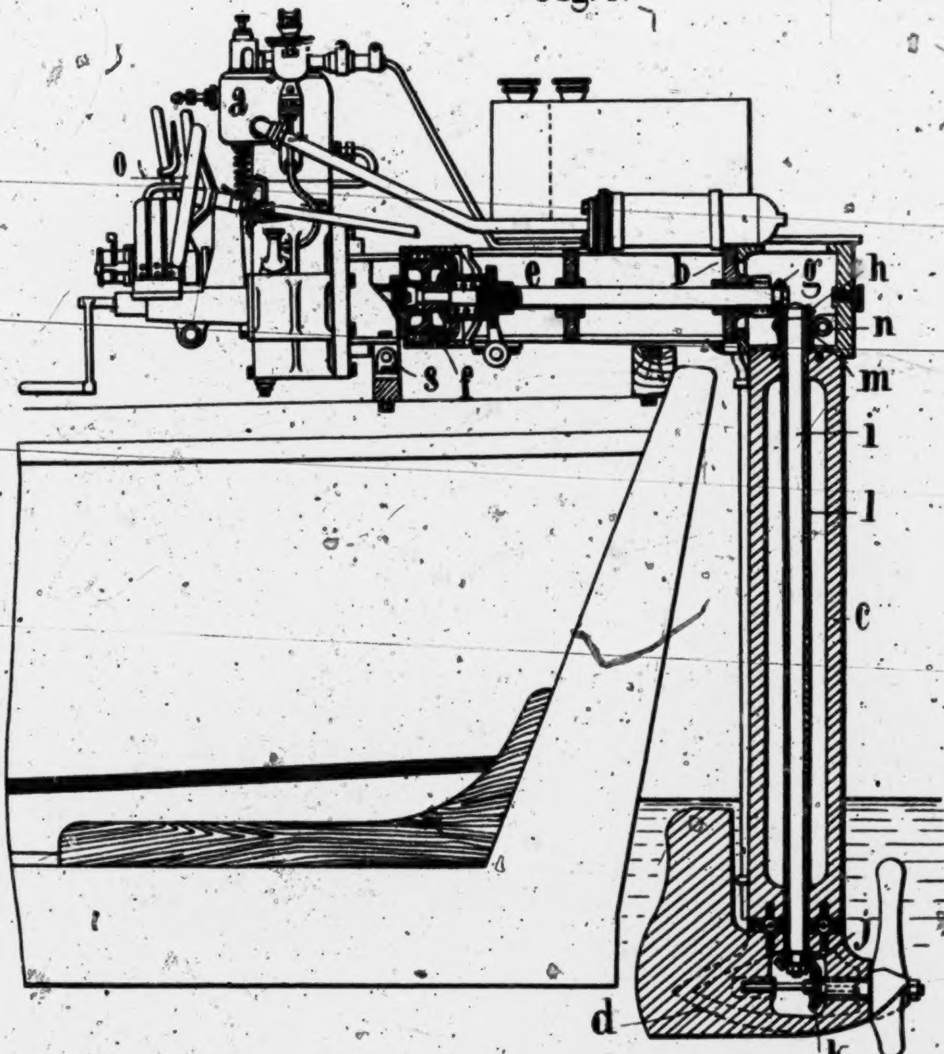
APPLICATION FILED DEC. 26, 1911.

1,034,987.

Patented Aug. 6, 1912.

4 SHEETS—SHEET 1.

Fig. 1.



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PROPELLING MECHANISM FOR BOATS.

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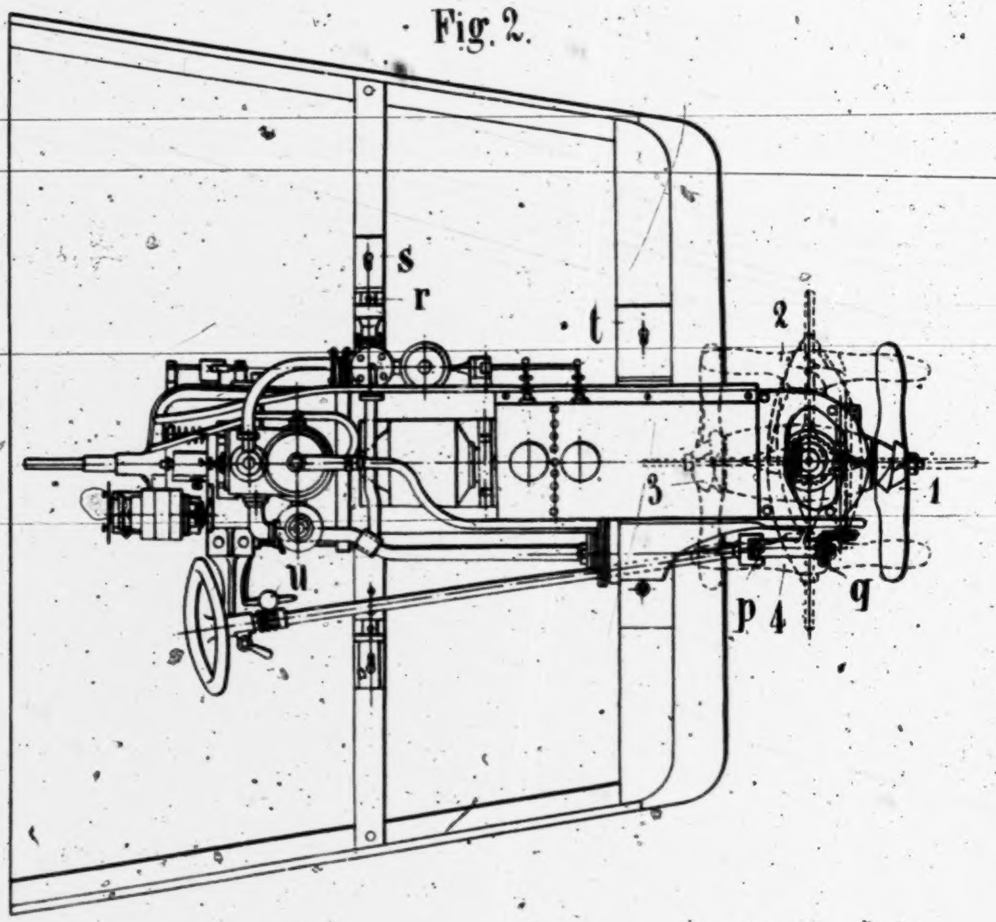
1,034,987. Patented Aug. 6, 1912.

4 SHEETS—SHEET 2.

Fig. 2.



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PROPELLING MECHANISM FOR BOATS.

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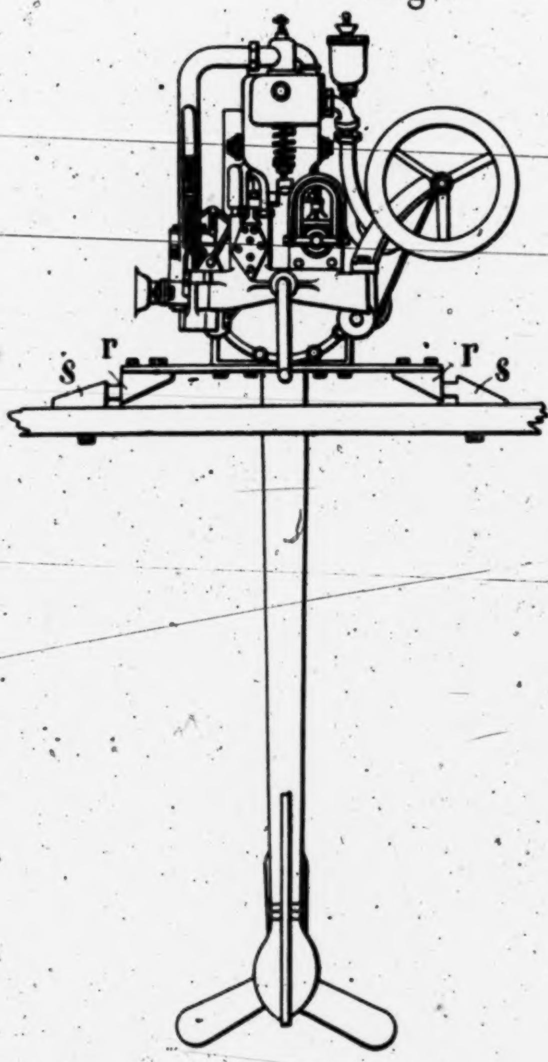
1,034,987.

Patented Aug. 6, 1912.

4 SHEETS—SHEET 3.

Fig. 3.



WITNESSES

[illegible]

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J. G. DUCASSOU.
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4 SHEETS—SHEET 4.

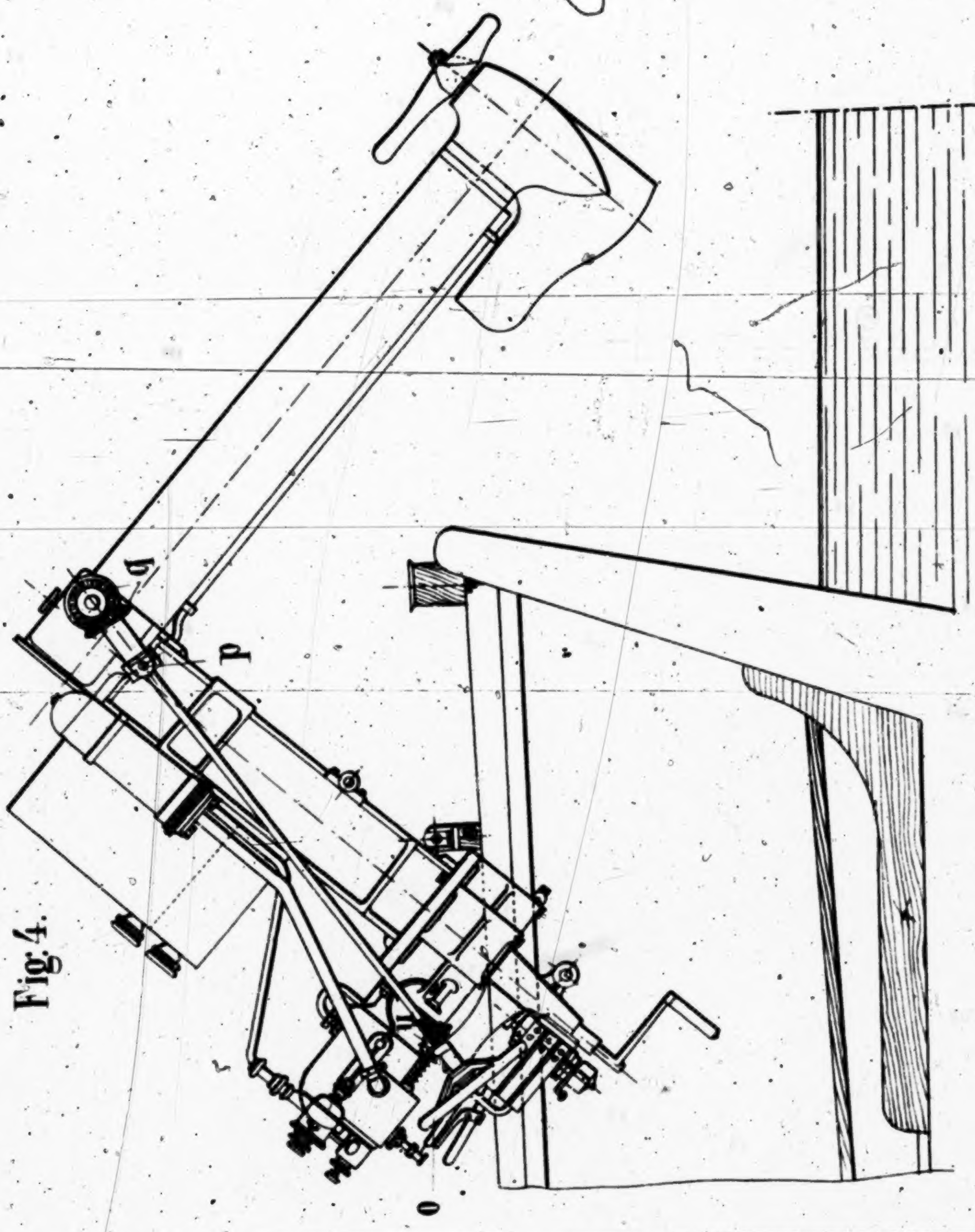

Fig. 4.

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[illegible]

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UNITED STATES PATENT OFFICE.

JOSEPH GEORGES DUCASSOU, OF PARIS, FRANCE, ASSIGNOR TO SOCIÉTÉ G. DUCASSOU & COMPAGNIE, OF PARIS, FRANCE.

PROPELLING MECHANISM FOR BOATS.

1,034,987. Specification of Letters Patent. Patented Aug. 6, 1912.

Application filed December 26, 1911. Serial No. 667,846.

To all whom it may concern:

Be it known that I, JOSEPH GEORGES DUCASSOU, a citizen of the Republic of France, and residing at Paris, France, have invented new and useful Improvements in Propelling Mechanism for Boats, of which the following is a specification.

This invention relates to an apparatus by means of which it is possible to convert immediately into motor-boats any sailing or rowing vessels, vessels generally towed, and others.

In order to make the explanation as clear as possible, a construction according to this invention is illustrated by way of example in the accompanying drawings.

Figure 1 is a vertical section showing the apparatus secured at the stern of a boat, Fig. 2 is a plan of the apparatus, Fig. 3 an end view and Fig. 4 shows the apparatus turned as will be hereinafter explained.

The device in question comprises four principal parts: The motor *a*, the frame *b*, the plunger arm *c*, the propeller holder block and rudder *d*.

The motor *a* which can use any desired fuel or mechanical power, drives the horizontal spindle *e* by means of a clutch *f*. The spindle *e* is provided at its end with a bevel pinion *g* engaging with the bevel pinion *h* secured to the end of the vertical spindle *i*. The other end of the spindle carries the pinion *j* engaging with the pinion *k* secured to the horizontal spindle of the propeller. This pinion can be reduced in its ratio to the desired extent, so as to obtain the best efficiency from the propeller. The movement of rotation is thus transmitted from the engine to the propeller.

The tube *l* concentric with the spindle *i* passes through the dipping or plunger arm and is secured to the block *d*. It is provided at its upper end with a pinion *m* with helical teeth engaging with a worm *n*. The latter is controlled by means of a steering wheel *o* arranged in front of the group, within reach of the pilot, and connected to the worm *n* by means of a Cardan joint *p* and two bevel pinions *q*. By rotating the hand wheel *o*, the propeller can be brought into the main positions 1, 2, 3, 4 (Fig. 2) as well as into any intermediate positions. The position 1 brings about the driving ahead, the position 2 turning to starboard, the position 3 driving astern, and the position 4 turning to port. The use of the worm *n* makes the steering non-reversible. A pointer *u* arranged in view of the pilot, shows to him the position of the propeller in the water.

The block *d* which carries the propeller, is provided at one of its ends with a blade playing the part of a rudder, so that the steering of the ship is obtained by manipulating the steering wheel of the block, even when the engine or motor is not working. In that case the block works like an ordinary rudder.

It will be seen that in this apparatus the propelling action is always exercised in the direction of the rudder for a complete and continuous revolution of the latter. This device has the advantage of utilizing the total force of the motor for propelling in any direction of driving, without modifying the direction of rotation of the propeller. This has an obvious advantage over any other apparatus in which the direction of the ship is obtained by modifying the direction of the axis of rotation of the propeller relatively to the axis of the ship. In prior devices this shifting was only possible in an arc of 180°, so that the reversing could be obtained only by changing the direction of rotation of the propeller or by using a reversible propeller. In the apparatus according to this invention, on the contrary, the axis of rotation of the propeller and the rudder which is secured to it, can make a complete revolution of 360° about a vertical axis.

The apparatus described, forming a rigid whole, can be adapted to any desired hull without modifying the latter in any way. It is secured to the same in the following manner: At the front portion of the frame *b* are secured two trunnions *r*, the bearings *s* of which are secured to the ship. In that way, the whole apparatus can be turned about a horizontal axis toward the interior of the ship, which enables the arm *c* to be raised out of water either for examining or for exchanging the propeller, or for preventing it from touching the bottom when passing a lock or when landing (Fig. 4). In the working position, the apparatus is fixed by means of two flanges or straps *t* which enable the frame to be almost instantaneously secured in horizontal position on the ship, by tightening two bolts.

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This device makes the up-keep of the apparatus very simple, as it is not necessary to take anything to pieces for examining or repairing the submerged portions. It makes possible motor boat navigation in water where grass would make impossible the use of a propeller that could not be easily examined, and in rivers of small depth where it is necessary to pass sand banks and rapids without touching the ground.

I claim—

1. In combination, a boat, a propelling mechanism therefor comprising an arm extending downwardly at the rear of the boat, a propeller block immersed in the water and rotatably connected to said arm and having a rudder portion, a propeller wheel carried by said block, connections for driving said propeller wheel, and means for adjusting the propeller block throughout a complete revolution of 360 degrees, substantially as described.

2. In combination, a boat, a propelling mechanism therefor comprising an arm extending downwardly at the rear of the boat, a propeller block immersed in the water and rotatively connected with said arm and having a rudder portion, and means for adjusting said block throughout a complete revolution of 360 degrees, substantially as described.

3. In combination, a boat, an angular frame pivoted on the boat to swing about a horizontal axis, said frame having a horizontal portion and a motor thereon and a vertical and downwardly extending portion, a propeller and rudder carried by the vertical portion and held immersed in the water, horizontal and vertical shafting connecting the motor and propeller, and means on the horizontal portion of the frame for adjusting the propeller and rudder throughout a complete revolution of 360 degrees, substantially as described.

4. In combination, a boat, a frame mounted to swing about a horizontal axis and having a horizontal portion extending rearwardly over the top of the boat and a vertical portion extending downwardly at the rear of the boat, means for locking the frame in a normal position, a block carried by the vertical portion part of the frame and having a rudder portion and held immersed in the water, a motor on the horizontal portion of the frame, a propeller carried by said block, horizontal and vertical shafting connecting the motor with the propeller, and horizontal and vertical adjusting means for turning the propeller block throughout a revolution of 360 degrees, substantially as described.

5. In combination, a boat, a frame mounted on the boat and having an arm portion immersed in the water, a block rotatively and reversibly mounted on said arm portion, and a rudder and propeller on said block, means for operating the propeller, and means for turning or reversing the block to steer and propel the boat in any direction, substantially as described.

6. In combination, a boat, a propeller and rudder, a frame suspending the propeller and rudder on the boat, means for operating the propeller, and means for changing the position of the rudder and propeller with respect to the boat to propel and steer the same in any direction, substantially as described.

7. In combination, a boat, a propeller and rudder in fixed relation with respect to each other, a frame suspending the propeller and rudder on the boat, means for operating the propeller, and means for changing the position of the rudder and propeller with respect to the boat to propel and steer the same in any direction, substantially as described.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

JOSEPH GEORGES DUCASSOU.

Witnesses:
EMILE LEDRET,
H. C. COXE.

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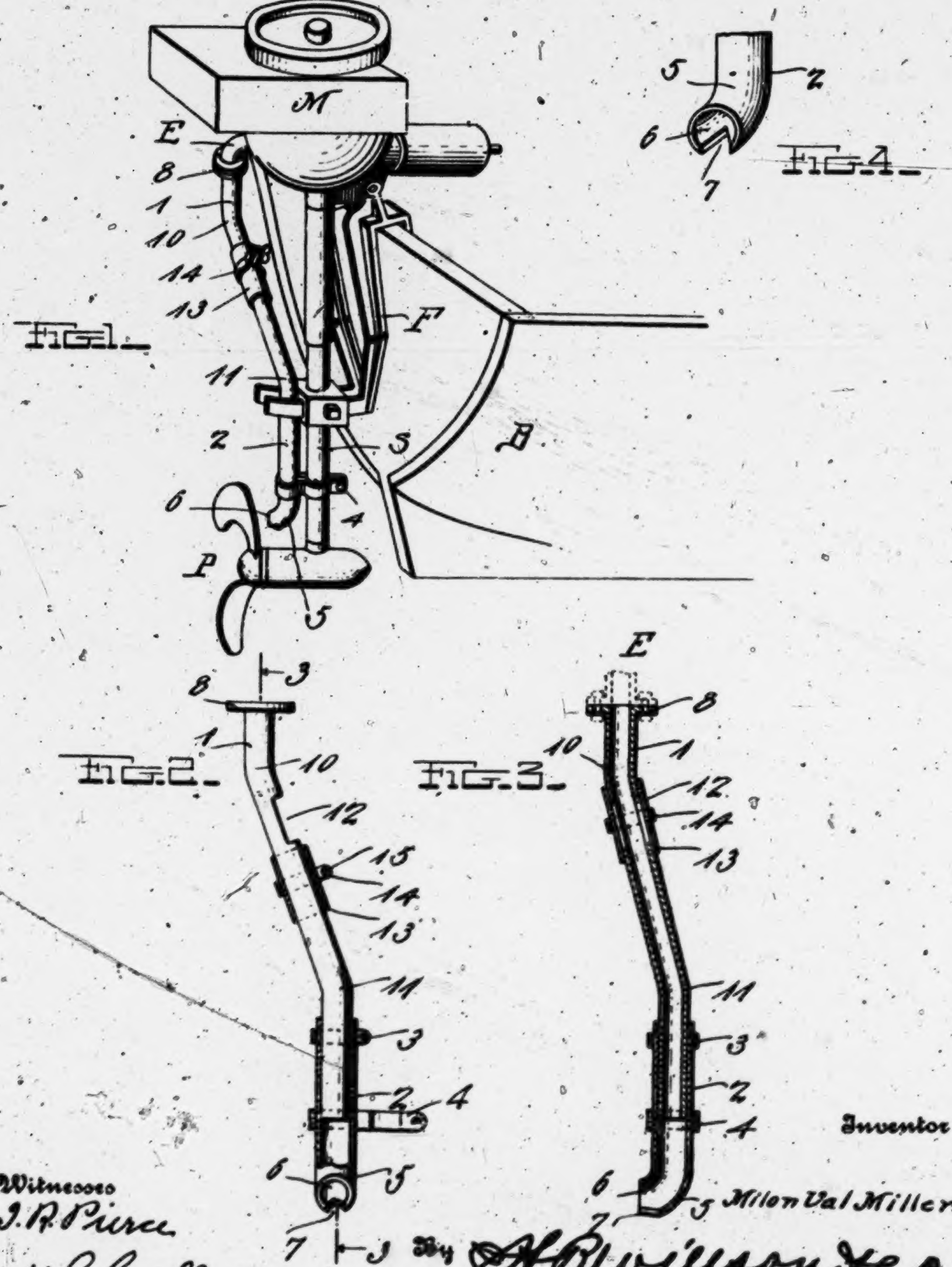
M. V. MILLER.

UNDER WATER EXHAUST.

APPLICATION FILED OCT. 28, 1912.

1,073,920. Patented Sept. 23, 1913.



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N. L. Collamer

Inventor
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By A. B. Willson & Co.

Attorneys

UNITED STATES PATENT OFFICE.

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UNDER-WATER EXHAUST.

1,073,920. Specification of Letters Patent. Patented Sept. 23, 1913.

Application filed October 28, 1912. Serial No. 728,281.

To all whom it may concern:

Be it known that I, MILON VAL MILLER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Under-Water Exhausts; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to internal combustion engines, and more especially to the exhaust treatment thereof; and the object of the same is to provide an exhaust for outboard gasolene engines such as are clamped over the stern of a launch, which exhaust will convey the gases from the engine to a point beneath the water level so as to muffle the sound of the pulsations, avoid smoke and odors, and produce suction on the exhaust pipe by disposing its outlet end just in advance of the propeller, meanwhile making provision for opening a relief in the exhaust when desired.

These objects are carried out by constructing the under water exhaust in a manner hereinafter more fully described and claimed, and as shown in the drawings wherein—

Figure 1 is a general perspective view of the rear end of a boat in outline with the "Evinrude" motor attached, showing the adaptation of my invention thereto. Fig. 2 is an enlarged rear elevation of my exhaust removed from the motor and boat, the same being shown partly in section. Fig. 3 is a central vertical sectional view throughout the length of the exhaust, on the line 3—3 of Fig. 2. Fig. 4 is a detail of the outlet end of the exhaust showing the notch in the bottom thereof.

In the drawings the letter B designates a launch or other boat, to whose stern in the present instance is attached a framework F carrying a motor M from which depends a sleeve S through which power is transmitted to the propeller P, and the exhaust of the motor is roughly indicated at E. The object of the present invention is to convey the exhaust gases from the point E to a point below the water level and just in advance of the propeller P, whereby the rotation of the latter will create suction on the exhaust so as to facilitate the running of the engine, and the fact that the exhaust gases are discharged below the water level will deaden the noise thereof and suppress the smoke and odor rising therefrom.

Coming now more particularly to the present invention, shown in the embodiment herewith as applied to a sleeve S which it will be observed is telescopic in the Evinrude motor so that the propeller P can be set at the desired elevation according to the build of the boat B, my exhaust consists of a pipe made also telescopic in order that it may be lengthened as the sleeve S is lengthened or shortened as the sleeve is reduced in length. This pipe has an upper section 1 over which telescopes a lower section 2, the sections being connected by any suitable means such as a clamp 3 which may be tightened up after adjustment and which possibly may serve as one of the means of supporting the device; the lower section 2 passes through another clamp 4 which in the present instance engages the sleeve S as shown, and its lower end is turned to the rear into an elbow 5 whose outlet end 6 stands just in front of the propeller P and whose lower side is notched in V-shape as seen at 7. The upper end of the upper section 1 is connected in any suitable manner, as by the clamp 8, with the exhaust E of the motor M. It follows that when the motor is started running, the exhaust gases are conveyed down through the sections 1 and 2, and by the elbow 5 are turned to the rear and delivered out through the end 6 directly toward and close in front of the propeller P so that the rapid rotation of the latter creates a partial vacuum within the elbow and therefore sucks on the gases therein and a draft is produced throughout the length of the exhaust while the propeller is running. The presence of the notch 7 in the bottom of the rear end of the elbow also assists in setting up the suction referred to, because while the boat is traveling forward the rearward movement of the water through this notch adds to the suction downward which is set up throughout the length of the exhaust.

In the adaptation of my invention to the Evinrude motor as illustrated, it becomes necessary to put elbows 10 and 11 in the upper section 1 so that the upper end thereof will stand a little to one side of and out of alinement with the lower end and with the lower section 2, and the upper extremity of the upper member can be clamped at 8

to the exhaust E of the motor. It will be clear that when this device is applied to other types of motors, these elbows 10 and 11 may be emphasized, otherwise disposed, or in some instances possibly omitted; but the purpose in providing them is to cause the upper extremity of the upper section to connect with the motor exhaust E, and the length of the lower section to follow the sleeve S or whatever other portion of the framework supports the drive shaft for the propeller P so that the outlet end 6 of the lower section shall stand strictly in front of the propeller blades.

An amplification or refinement of my invention consists in providing one of the sections at a suitable point with a relief opening 12 herein shown as produced by cutting away one side of the upper section 1, and this opening is adapted to be closed or opened at the will of the operator. In the present instance I have shown the closure as consisting of a collar 13 slidably inclosing the upper section 1 and adapted to be moved so as to expose the opening 12 as shown in Fig. 2 or to close the same as shown in Fig. 3, the collar in this instance being surrounded by a clamp 14 which may be tightened by means of a set screw 15 through its arms and both standing within reach of the operator. With the set screw adjusted moderately tight the operator can grasp the clamp 14 and slide the collar upward or downward, thus closing or opening the relief 12 at will; or he may tighten the set screw when the collar stands over the relief, and the exhaust pipe will then be complete from the exhaust E to the outlet end 6 of the lower section. Any other suitable means may be provided for producing a relief within the exhaust, the obvious purpose of which is to open it into the air when the operator desires to start or speed up the engine, or when he wishes to signal or to ascertain if the exhaust contains carbon deposits.

I do not wish to limit myself to the exact details of construction, and the relief may be added or not as desired. It is quite obvious that the elbows 10 and 11 are only to be employed when the shape of the motor and its framework require. The sizes and materials of parts are not essential to the present invention.

What is claimed as new is:

1. The combination with a boat, a motor, an upright framework detachably connected with the stern of the boat, an upright sleeve carried by the framework, and the propeller at the lower end of said sleeve; of an exhaust pipe connected at its upper end with the exhaust of the motor, its body led downward alongside said sleeve, and its lower end having an elbow whose outlet end is directed rearward toward and stands close to the propeller so that rotation thereof sets up suction in said pipe and means for clamping said pipe to said sleeve.

2. The combination with a boat, and a motor therefor including a framework clamped to the stern of the boat, an upright carried by the framework, and the propeller at the lower end of said upright; of an exhaust pipe connected at its upper end with the exhaust of the motor, its body led downward alongside said upright, and its lower end having an elbow whose outlet end is directed rearward toward the propeller, the pipe being made in sections telescoping on each other, a clamp for holding the sections after they are adjusted, and clamps for connecting said sections with the framework and upright.

3. The combination with a boat, and a motor therefor including a framework clamped to the stern of the boat, an upright sleeve carried by the framework, and the propeller at the lower end of said sleeve; of an exhaust made in two sections whose meeting ends are telescopically mounted upon each other, a clamp for holding said ends after they have been adjusted, the upper end of the upper section being connected with the motor-exhaust and the lower end of the lower section being directed to the rear in front of the propeller, means for connecting said sections with the framework and sleeve; the upper section being provided with a relief opening, and means for closing the latter at will.

4. The combination with a boat, and a motor therefor including a framework clamped to the stern of the boat, an upright carried by the framework, and the propeller at the lower end of said upright; of an exhaust made in two sections whose meeting ends are telescopically mounted upon each other, a clamp for holding said ends after they have been adjusted, the upper end of the upper section being connected with the motor-exhaust and the lower end of the lower section being directed to the rear in front of the propeller, means for connecting said sections with the framework; the upper section having elbows within its length throwing its upper extremity out of alinement with the lower section and also being pierced with a relief opening between said elbows, a collar slidably mounted on this section between its elbows and adapted to be moved over said opening, a clamp surrounding said collar, and a set screw through the clamp arms, for the purpose set forth.

5. The combination with a boat, and a motor therefor including a framework clamped to the stern of the boat, an upright carried by the framework, and the propeller at the lower end of said upright; of an ex-

haust made in two sections whose meeting ends are telescopically mounted upon each other, means for holding said sections after they have been adjusted, the upper end of the upper section being connected with the motor-exhaust and the lower end of the lower section being directed to the rear, means for connecting said sections with the framework, the upper section having a relief opening, and a collar slidably mounted on this section and adapted to be moved over said opening, for the purpose set forth.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

MILON VAL MILLER.

Witnesses:

FRAXANA ELLEN MILLER,

MARY ROSETTHA MILLER.

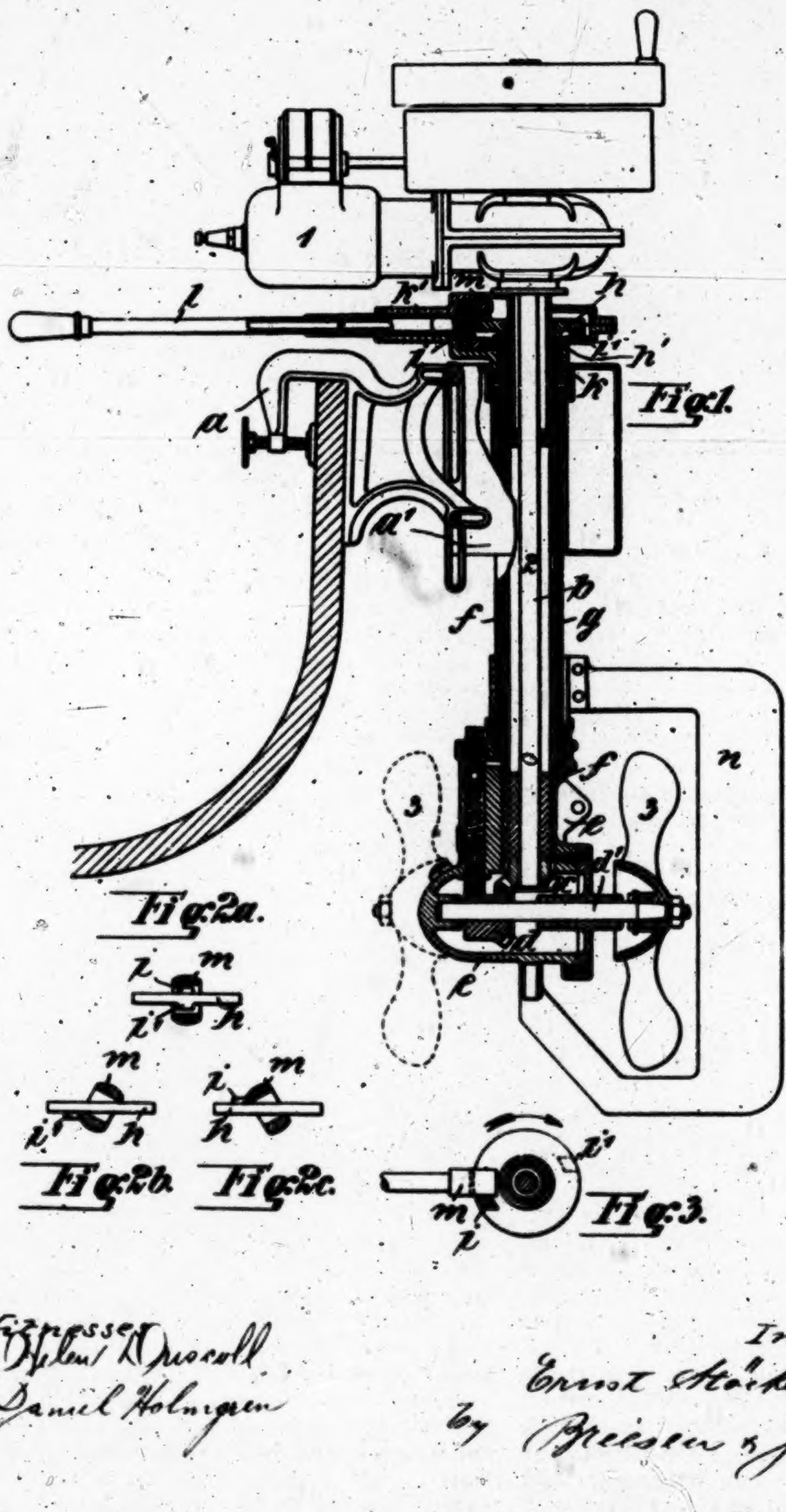
388

E. STÖCKEMANN.

STEERING AND PROPELLING MECHANISM FOR VESSELS.

APPLICATION FILED AUG. 16, 1913.

1,131,287. Patented Mar. 9, 1915.



Witnesses
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Daniel Holmgren

Inventor:
Ernst Stöckemann
by Briesen & Knauth
Att's

UNITED STATES PATENT OFFICE.

ERNST STÖCKEMANN, OF BERLIN, GERMANY.

STEERING AND PROPELLING MECHANISM FOR VESSELS.

1,131,287. Specification of Letters Pate t. Patented Mar. 9, 1915.

Application filed August 16, 1913. Serial No. 785,060.

To all whom it may concern:

Be it known that I, ERNST STÖCKEMANN, a citizen of the German Empire, residing at 18 Siemenstrasse, Berlin, N. W. 87, Germany, have invented certain new and useful Improvements in Steering and Propelling Mechanism for Vessels, of which the following is a specification, reference being had to the accompanying drawings.

In the known devices for propelling and steering vessels by means of rotatable screw propellers the rotation of the screw around a vertical axis in order to effect the reversal of the vessel's movement is usually brought about by means of toothed spur or chain and sprocket gear. In propelling devices for vessels in which the motor and the screw propeller, are adapted to be easily attached to and removed from the vessel, the provision of a reversing gear of this kind results in considerably increasing the weight and consequently also the cost of the motor, and it is for this reason that it has been proposed to employ motors which are themselves reversible. In such cases however it has been necessary first to stop the motor, then to reverse the ignition and finally again to start the motor in the opposite direction, a somewhat complicated procedure, which takes up too much time to be satisfactory in practice.

Now in accordance with the present invention the reversal of the direction of movement of the vessel is effected by mounting the propeller in a casing so arranged that it can be fixed or freely moved about the axis of the vertical driving shaft carrying the bevel gear by means of which the motion of the motor is transmitted to the propeller, the arrangement being such that the propeller and the casing can either rotate about the vertical axis on account of the torque exerted by the propeller without exerting any propelling action on the vessel or that, when moved into the position in which the casing is arrested and held, the vessel can be driven ahead, athwartship. or astern, as will hereinafter be more fully described. To enable the casing to be held in any desired position there is attached to it a vertical tube which surrounds the vertical driving shaft and the top of which terminates in a flange, provided on its upper and its lower side with a pair of stops arranged at 180° apart and embraced by a fork which is attached to the end of a tiller rotatable about its own longitudinal axis and also about the axis of the vertical driving shaft. According as the tiller has imparted to it a right-handed or a left-handed rotation about its own axis, so as to rock the fork in one or the other direction, one or the other of the two stops will come in contact with it and by this means will arrest the rotating casing. When the fork occupies its normal central or vertical position both stops can pass easily through it.

The accompanying drawings illustrate apparatus in accordance with this invention.

Figure 1 shows in sectional side elevation the construction of the steering mechanism, Figs. 2[a], 2[b] and 2[c] diagrammatically illustrate the different positions of the fork relatively to the stop, and Fig. 3 is a plan of the fork and the steering flange.

The construction shown in the drawings comprises a horizontal motor 1 with a vertical driving shaft 2, which is secured to the stern of the vessel together with the steering and driving mechanism by means of the clamp *a* and the suspension block or bearing *a'*. The driving bevel wheel *c*, which engages with the bevel wheel *d* on the propeller shaft *d'* is mounted on the lower end of the driving shaft 2. The casing *e* is rigidly connected with a tubular shaft *f* rotatably mounted in the tubular steering shaft *g* and provided at its upper end with a flange *h* whereon there are mounted two contact studs *i* and *i'*. The sleeve *h'* of the flange serves also as a bearing coöperating with the widened upper edge of the tubular shaft *g*, which is rotatably mounted in the suspension block *a'* and terminates at its upper end in a housing *k* in the lateral tubular extension *k'* of which the tiller *l* is rotatably mounted.

At its inner end the tiller *l* is provided with a fork *m*, the aperture of which is of such size as to permit of the free passage of the flange *h* together with the contact studs *i* and *i'* when the tiller is in its central position. When the tiller is adjusted to its normal central position and the motor is started, the casing *e* together with the shaft *f* and the flange *h* will, owing to the reaction of the water, continuously rotate about its vertical axis so that the vessel will remain stationary notwithstanding the working of the motor. It is obvious that when casing *e* is released

while beveled gear wheel c is continuously rotated in one direction, wheel d will roll on wheel c on account of the fluid reacting on the blades that revolve about the horizontal propeller-axis. This circling of casing e and propeller 3 about shaft b continues until the casing e is arrested whereupon wheel d and propeller 3 will rotate about their horizontal axis only, shaft d remaining relatively to the longitudinal axis of the vessel, at the precise position at which its revolution about shaft b has been stopped by the arrest of the casing. Thus by imparting to the tiller l a slight right-handed rotation about its longitudinal axis, the passage for the contact stud i is closed and the rotation of the casing e arrested. The contact stud i is so located, that when the tiller l is rotated to the right around its longitudinal axis and the stud i comes to bear against the head of the fork m, the casing e and the propeller shaft will lie in the direction of the length of the vessel, which will thus be caused to move ahead. The position of the contact stud i' is such that when the tiller l is rotated slightly to the left about its longitudinal axis the casing is arrested with the propeller in the position indicated by broken lines whereupon the vessel is caused to move astern. As on account of the torque the contact studs will be constantly pressed against the fork m of the tiller l, as long as a right or left-handed rotation is imparted thereto, it is obvious that the propeller must participate in each oscillatory movement of the tiller l in the horizontal plane, notwithstanding that the fork m is not positively connected to the flange h.

To enable the vessel to be steered even when the motor is stopped there is provided on the tubular shaft g a rudder blade n.

What I claim is:—

1. A device of the character described comprising a vertically disposed driving shaft, a tubular shaft rotatably surrounding the same, a casing fast on the tubular shaft, a propeller journaled in the casing and intergeared with the driving shaft, said propeller being adapted to impart a rotary movement to the casing and to the tubular shaft, means for checking said rotary movement, an additional tubular shaft surrounding the first named tubular shaft, and a rudder carried by said additional shaft.

2. A device of the character described, comprising a vertically disposed driving shaft, an inner tubular shaft rotatably surrounding the same, a casing fast on the lower end of the inner tubular shaft, a propeller journaled in the casing and intergeared with the driving shaft, a first coupling member on the upper end of the inner tubular shaft, an outer tubular shaft encompassing the inner tubular shaft, a rudder carried by the outer tubular shaft, a housing on the upper end of the outer tubular shaft, a tiller engaging said housing, and a second coupling member on said tiller.

3. In a propelling and steering device for vessels, a motor, a vertically disposed driving shaft rotatable by said motor, a horizontally disposed propeller shaft, a propeller secured thereon, intermeshing gear wheels on said driving and propeller shafts, a casing wherein said propeller shaft is journaled, a tubular shaft secured to said casing, arranged concentrically with said vertical driving shaft and rotatable relatively thereto, a disk secured to the upper end of said hollow shaft, stops provided on the upper and on the lower side of said disk diametrically opposite to each other, a tiller adapted to be rotated about its own axis, and also about the axis of said driving and tubular shafts, said tiller being provided with a fork adapted by the rotation of the tiller about its axis to be brought into engagement with one or other of said stops.

4. In a propelling and steering device for vessels, a motor, a vertically disposed driving shaft rotatable by said motor, a horizontally disposed propeller shaft, a propeller secured thereon, intermeshing gear wheels on said driving and propeller shafts, a casing wherein said propeller shaft is journaled, a tubular shaft secured to said casing, arranged concentrically with said vertical driving shaft and rotatable relatively thereto, a disk secured to the upper end of said hollow shaft, stops provided on the upper and on the lower side of said disk diametrically opposite to each other, a tiller adapted to be rotated about its own axis, and also about the axis of said driving and tubular shafts, said tiller being provided with a fork adapted by the rotation of the tiller about its axis to be brought into engagement with one or other of said stops, a suspension block whereon said propelling and steering device is suspended, and a clamping device carried by said suspension block whereby said block can be clamped to a vessel to be propelled and steered.

5. In a propelling and steering device for vessels, a motor, a vertically disposed driving shaft rotatable by said motor, a horizontally disposed propeller shaft, a propeller secured thereon, intermeshing gear wheels on said driving and propeller shafts, a casing wherein said propeller shaft is journaled, a tubular shaft secured to said casing, arranged concentrically with said vertical driving shaft and rotatable relatively thereto, a rudder plate secured to said tubular shaft, a disk secured to the upper end of said hollow shaft, stops provided on the upper and on the lower side of said disk diametrically opposite to each other, a tiller adapted to be rotated about its own axis, and also about the axis of said driving and

tubular shafts, said tiller being provided with a fork adapted by the rotation of the tiller about its axis to be brought into engagement with one or other of said stops.

6. In a device of the character described, a driving shaft adapted to be supported by a vessel and mounted in a substantially vertical position, a propeller shaft intergeared with the driving shaft and extending at an angle thereto, a propeller on the propeller shaft, said propeller causing the propeller shaft to be rotated about the driving shaft, and means for automatically checking said rotary movement of the propeller shaft about the driving shaft upon its arrival in a position that extends in substantial parallelism with the longitudinal axis of the vessel.

7. In a device of the character described, a driving shaft adapted to be supported by a vessel and mounted in a substantially vertical position, a propeller shaft intergeared with the driving shaft and extending at an angle thereto, a propeller on the propeller shaft, said propeller tending to continuously rotate the propeller shaft about the driving shaft, and means for releasing the propeller shaft and for subsequently automatically checking the rotary movement thereof about the driving shaft upon the arrival of the propeller shaft in a position extending in substantial parallelism with the axis of the vessel.

8. In a device of the character described, a propeller, a shaft carrying the same, normally locked means for supporting the propeller-shaft, and means for rotating said shaft together with the propeller, a release of the propeller-shaft-supporting means causing said last named means to be reversed with respect to the longitudinal axis of the vessel, owing to the resistance offered by the water to the propeller and to be relocked after such reversal.

9. In a device of the character described, a propeller, a shaft carrying the same, pivoted means for supporting the propeller-shaft, means for rotating said shaft together with the propeller, whereby said propeller tends to continuously rotate the shaft-supporting means on its pivot, and means for releasing the propeller-shaft-supporting means and for subsequently automatically checking the rotary movement of said supporting means upon a rotation of said last named means through an angle of 180 degrees.

10. A device of the character described comprising a vertically disposed driving shaft, a tubular shaft rotatably surrounding the same, a normally locked casing fast on the tubular shaft, a propeller journaled in the casing and intergeared with the driving shaft, said propeller being adapted to impart a rotary movement to the casing and to the tubular shaft, upon a release of the casing, and means for automatically arresting said rotary movement of the casing and tubular shaft after having performed a rotation through an angle of 180 degrees after such release.

11. In a device of the character described, a driving shaft, adapted to be supported by a vessel, said driving shaft extending in a substantially vertical direction, a propeller shaft operable by the driving shaft and extending at an angle thereto, a propeller on the propeller shaft, said propeller tending to continuously circle about the driving shaft owing to the resistance encountered within the water, said continuous circling of the propeller effecting a stoppage of the vessel, while the propeller continues to rotate on its axis, and means for checking the circling motion of the propeller for effecting a movement of the vessel.

12. In a device of the character described, a substantially upright driving shaft adapted to be supported by a vessel, a casing freely rotatable around said driving shaft, a propeller journaled in said casing and operable by the driving shaft, said propeller tending to continuously circle about the driving shaft thereby effecting a stoppage of the vessel, and stops for the casing adapted to check the circling motion of the propeller for effecting either a forward movement or a backward movement of the vessel.

In testimony whereof I affix my signature in presence of two witnesses.

ERNST STÖCKEMANN.

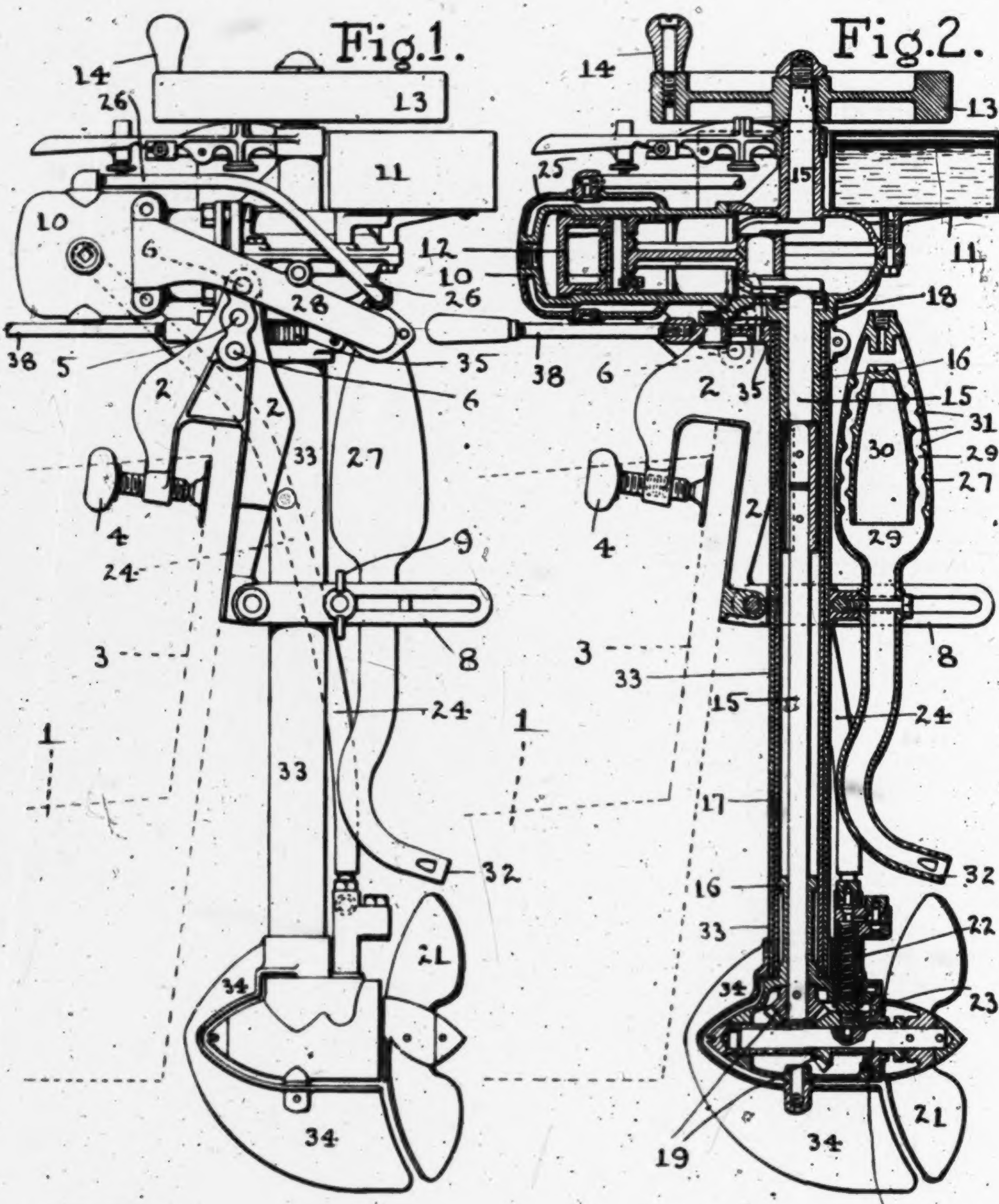
Witnesses:
HENRY HASPER,
ARTHUR SCHROEDER.

H. J. PERKINS.
MARINE PROPULSION MECHANISM.
APPLICATION FILED JAN. 31, 1914.

1,131,862.

Patented Mar. 16, 1915.
4 SHEETS—SHEET 1.

Fig.1. Fig.2.



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MARINE PROPULSION MECHANISM.
APPLICATION FILED JAN. 31, 1914.

1,131,862.

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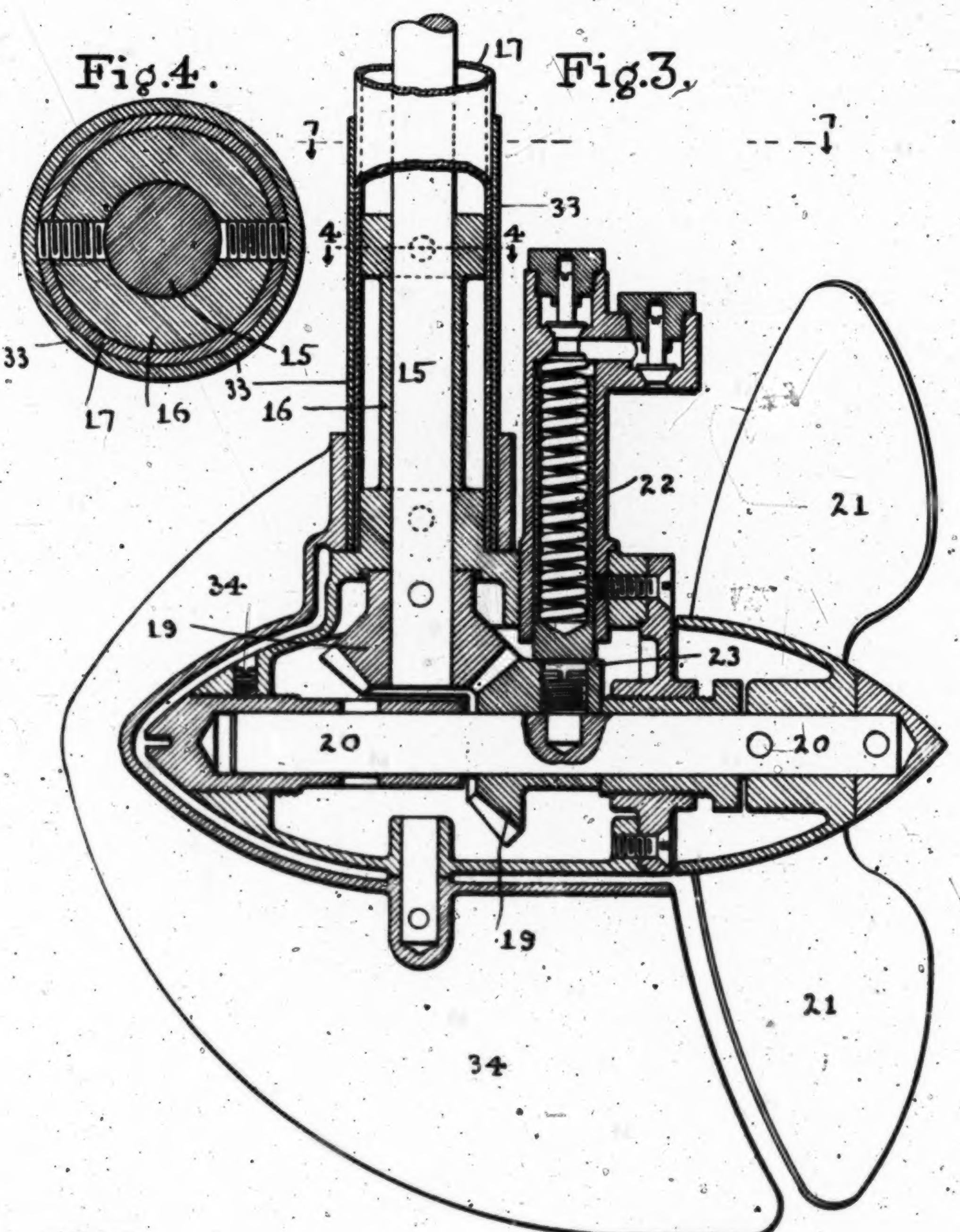
4 SHEETS—SHEET 2.

Fig. 4.

Fig. 3.



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H. J. PERKINS.

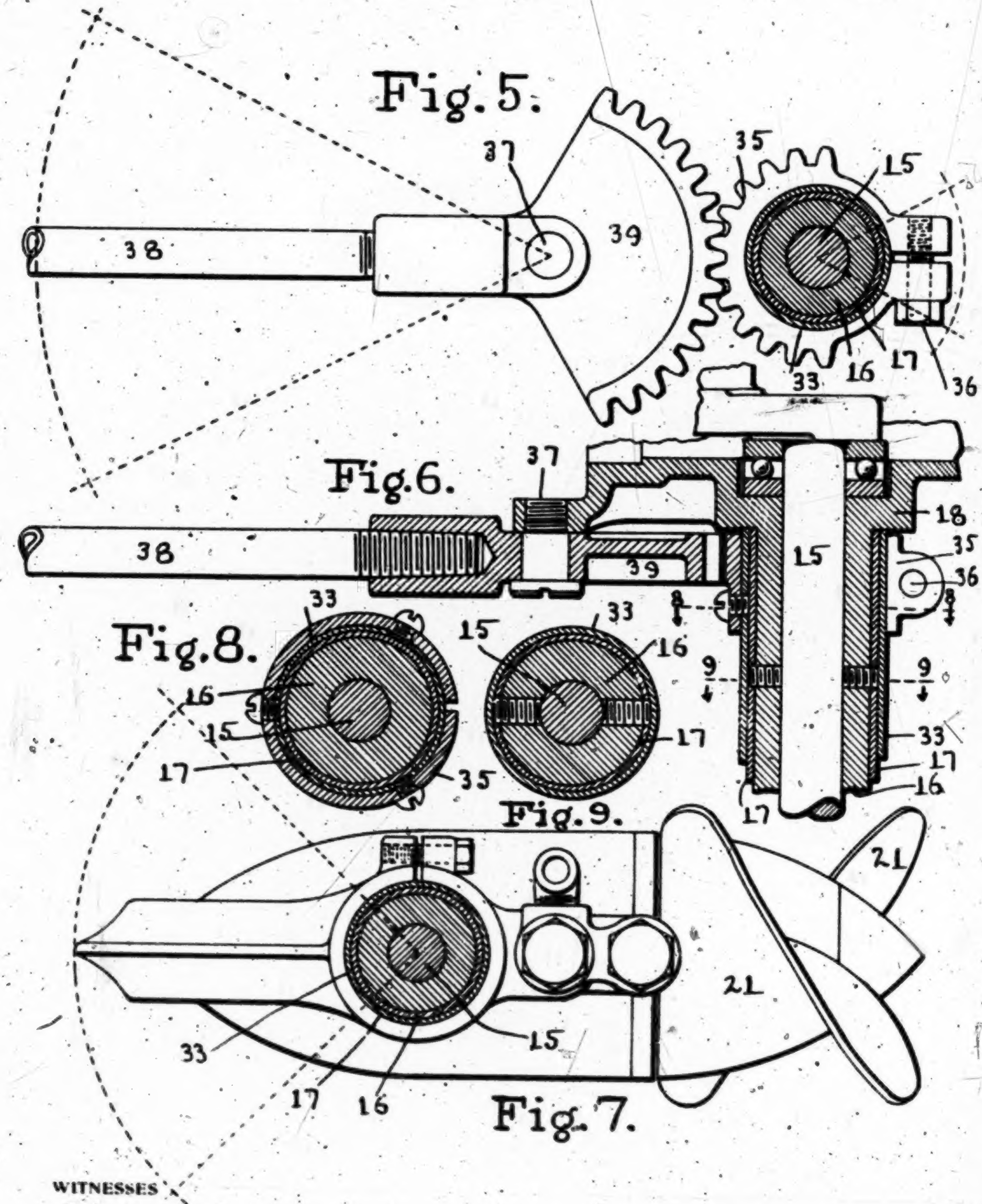
MARINE PROPULSION MECHANISM.

APPLICATION FILED JAN. 31, 1914.

1,131,862.

Patented Mar. 16, 1915.

4 SHEETS—SHEET 3.



WITNESSES

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Harry J. Perkins

BY

Cyrus W. Rice

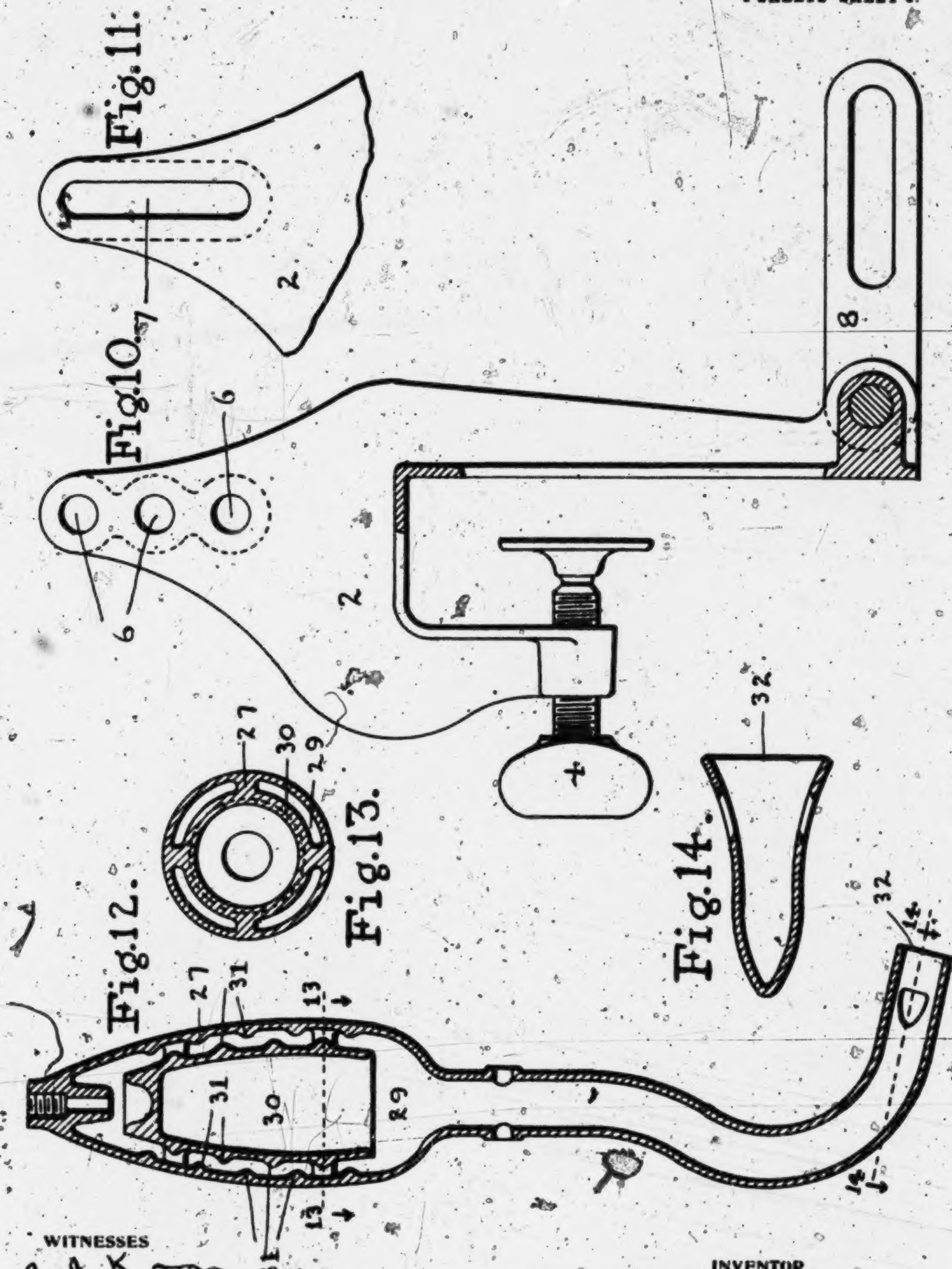
his ATTORNEY

400

H. J. PERKINS.
MARINE PROPULSION MECHANISM.
APPLICATION FILED JAN. 31, 1914.

1,131,862.

Patented Mar. 16, 1915.
4 SHEETS—SHEET 4.



WITNESSES
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INVENTOR
Harry J. Perkins
BY
Cyrus W. Rice
his ATTORNEY

UNITED STATES PATENT OFFICE.

HARRY J. PERKINS, OF GRAND RAPIDS, MICHIGAN.

MARINE PROPULSION MECHANISM.

1,131,862. Specification of Letters Patent. Patented Mar. 16, 1915.

Application filed January 31, 1914. Serial No. 815,690.

To all whom it may concern:

Be it known that I, HARRY J. PERKINS, a citizen of the United States, residing at Grand Rapids, in the county of Kent and State of Michigan, have invented new and useful Improvements in Marine Propulsion Mechanisms, of which the following is a specification.

My present invention relates to marine propulsion mechanism, and its object is to provide mechanism of that character which shall be simple and economical in construction and easy and efficient in operation. This and any other objects hereinafter appearing are attained by, and the invention finds a preferable embodiment in, the structure hereinafter described and illustrated by the accompanying drawings, in which:

Figure 1 is a side elevation of said structure: Fig. 2 is a vertical central section of the same: Fig. 3 is a like view of the lower part thereof: Fig. 4 is a transverse section on line 4—4 of Fig. 3: Fig. 5 is a top plan view of the tiller and a transverse section of the rudder stock, crank shaft, etc: Fig. 6 is a fragmentary view of the same parts mostly in vertical central section: Fig. 7 is a transverse section of the rudder stock, crank shaft, etc., on line 7—7 of Fig. 3: Fig. 8 is a transverse section on line 8—8 of Fig. 6: Fig. 9 is a like section on line 9—9 of Fig. 6: Fig. 10 is a side elevation of the supporting frame: Fig. 11 is a fragmentary side elevation of a part of the same, showing a variant construction: Fig. 12 is a vertical central sectional view of the exhaust silencer: Fig. 13 is a transverse section thereof on line 13—13 of Fig. 12: and Fig. 14 is a sectional view on line 14—14 of Fig. 12.

My marine propulsion mechanism is adapted to be removably attached to a boat 1 (indicated in dotted lines in Figs. 1 and 2), as by the supporting frame 2 straddling the stern board 3 whereto it is clamped as by a suitable screw 4. The rest of the mechanism is adjustably carried by this supporting frame, so that it may be held in different positions vertically relative thereto, by its supporting bolt 5 adapted to be inserted into any one of a series of orifices 6 in said frame, or to be passed through a slot 7 (as particularly shown in Fig. 11); and also so that it may be held at the proper angular position relatively to the stern board, as by the arm 8 pivoted on said frame and having a clamping nut 9.

The internal combustion engine is of common type, having a cylinder 10, fuel tank 11, piston 12, fly wheel 13 with cranking handle 14, engine shaft or crank shaft 15, etc.; bearings 16 for this shaft are carried within a supporting sleeve 17 borne by the engine frame 18; bevel gears 19 drive the propeller shaft 20 carrying the propeller 21. Suitable pumping mechanism 22 operated by the cam 23 supplies cooling water through a flexible tube 24 to the water jacket chamber 25; the overflow water from this chamber runs through a pipe 26 to the exhaust silencer 27 where it meets the gases, etc., constituting the "exhaust" from the engine, conducted therefrom by the exhaust pipe 28. This exhaust silencer has a chamber 29 containing a bell 30, the inner wall of the chamber and the external surface of the bell being provided with alternately disposed deflectors 31 so that the water and exhaust will in passing downwardly, be thoroughly commingled, thus to minimize the noise of the exhausting of the engine, to which end the under-water discharge port 32 of the silencer also contributes. The rudder stock is a sleeve 33 surrounding and having its rotary bearing on the supporting sleeve 17 and carrying the rudder blade 34 extending both above and below the propeller shaft; a geared segment collar 35 is carried by the rudder stock being clamped thereto as by a screw bolt 36. Pivoted at 37 on the engine frame is the tiller 38 having a geared segment 39 intermeshing with the segment 35 to turn the rudder.

Not confining myself to details of construction shown or described, I claim:—

1. In mechanism of the character described, a supporting frame having a plurality of orifices arranged one above another, means for securing said frame to a boat, an engine frame carrying an engine and propeller and also a rudder, and a bolt adapted to support the engine frame and to pass through any of said orifices to hold the engine frame in a desired position vertically relatively to the supporting frame, the rudder having a swinging horizontal movement relatively to the engine frame.

2. In mechanism of the character described, an engine frame carrying an engine and propeller, a vertical rotatable shaft for

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driving the propeller by the engine, and a rudder stock carrying a rudder blade and rotatable for steering on bearings surrounding said shaft.

3. In mechanism of the character described, an engine frame carrying an engine and propeller, a vertical rotatable shaft for driving the propeller, a rudder stock rotatable for steering on bearings surrounding said shaft and having a rudder blade extending below the propeller's axis.

4. In mechanism of the character described, an engine frame carrying an engine and propeller, a vertical rotatable shaft for driving the propeller, a rudder stock carrying a rudder blade and rotatable for steering on bearings surrounding said shaft and having a segmental gear, and a pivoted tiller having a segmental gear, meshing with the rudder stock's said gear to rotate the same.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

HARRY J. PERKINS.

Witnesses:

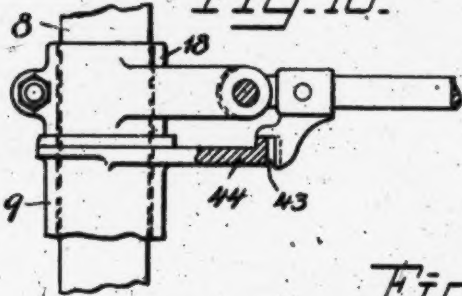
CYRUS E. PERKINS,
ELBERT F. LEWIS.

404

C. A. & O. W. HULT.
OUTBOARD MOTOR.
APPLICATION FILED JULY 3, 1913.

1,146,427. Patented July 13, 1915.
3 SHEETS—SHEET 1.

Fig. 10.



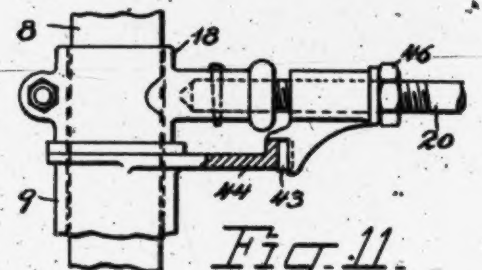


Fig. 11.

Fig. 1.

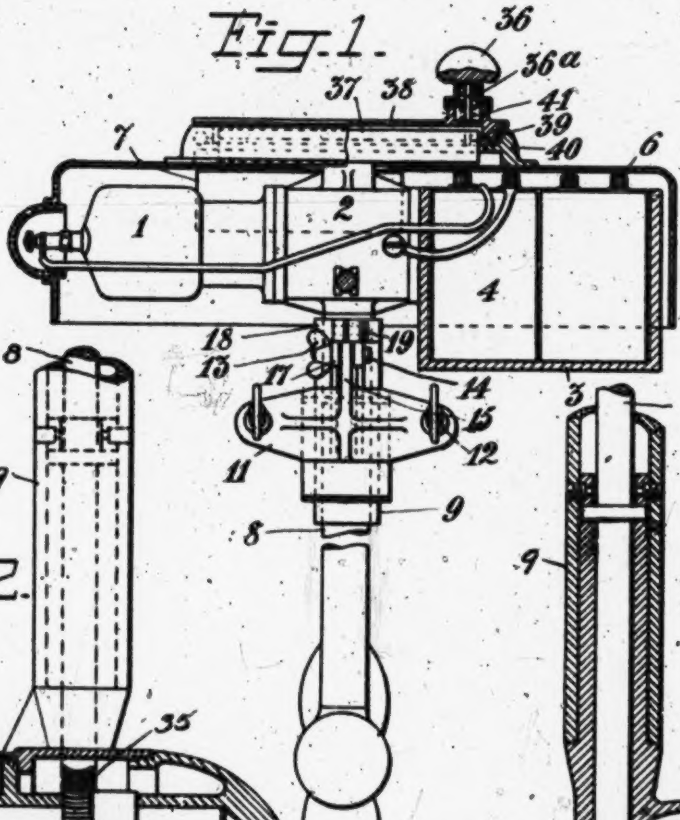


Fig. 12.

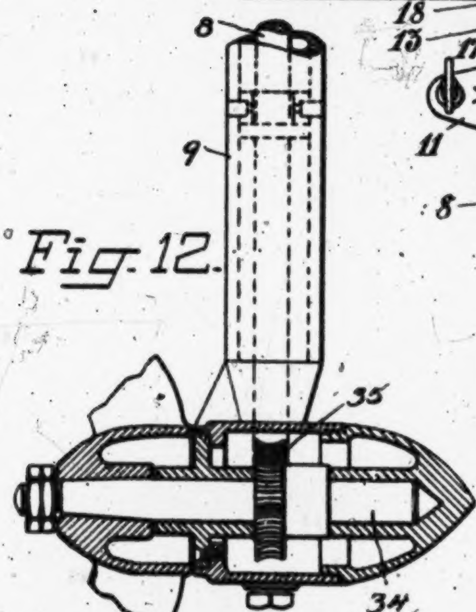
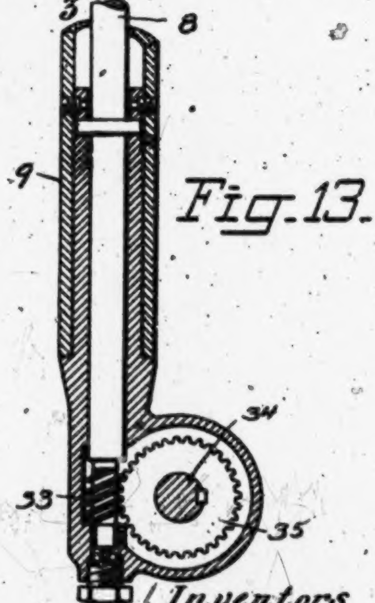


Fig. 13.



Witnesses

[illegible]

[illegible]

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Oscar Walfrid Hult
by [illegible]
their Attorney

406

C. A. & O. W. HULT.
OUTBOARD MOTOR.
APPLICATION FILED JULY 3, 1913.

1,146,427. Patented July 13, 1915.
3 SHEETS—SHEET 2.

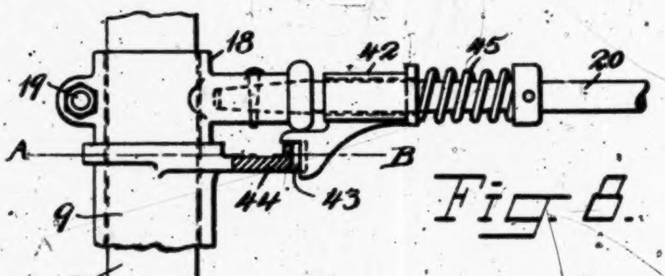

Fig. 8.

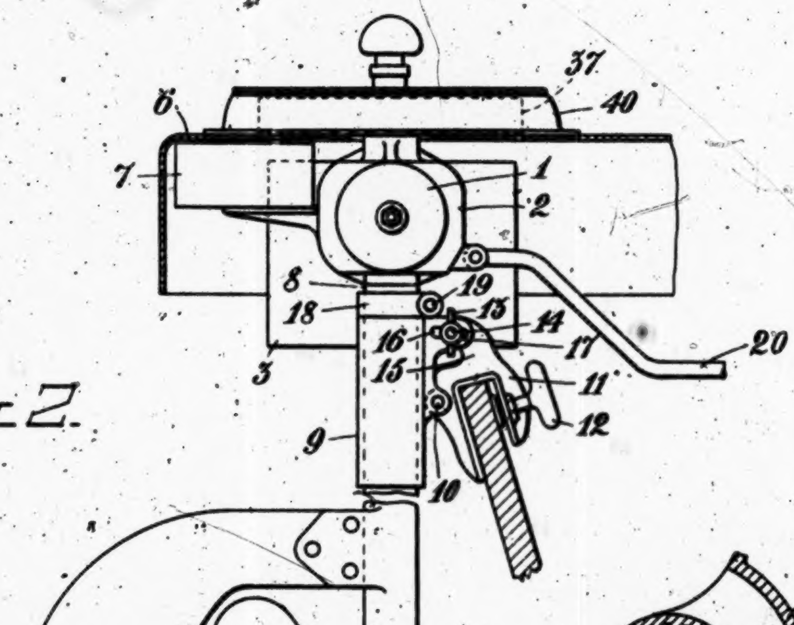

Fig. 2.

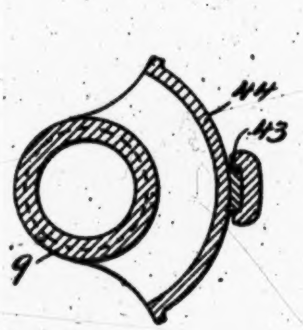

Fig. 9.

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Clarence Franck

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Oscar Walfrid Hult
by [illegible]
their Attorney

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C. A. & O. W. HULT.
OUTBOARD MOTOR.
APPLICATION FILED JULY 3, 1913.

1,146,427.

Patented July 13, 1915.
3 SHEETS—SHEET 3.

Fig. 3.

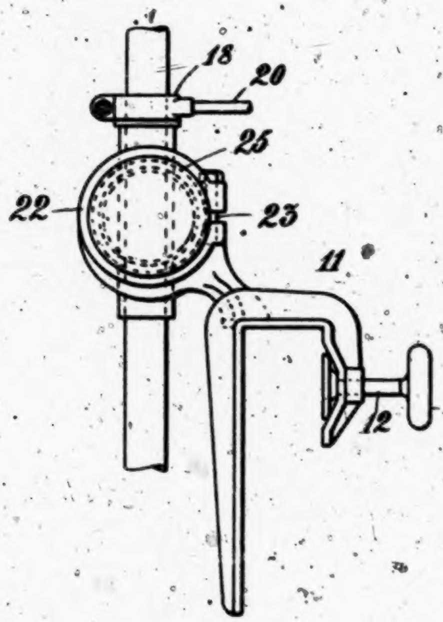


Fig. 6.

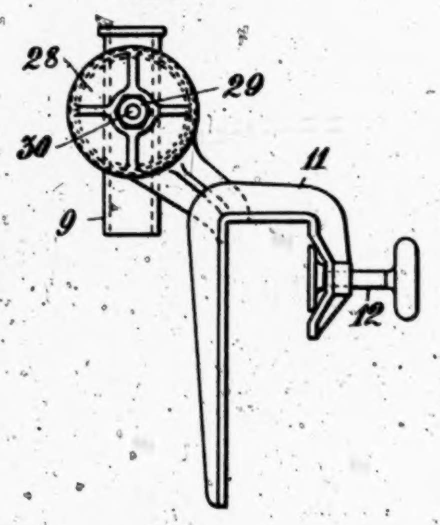


Fig. 4.

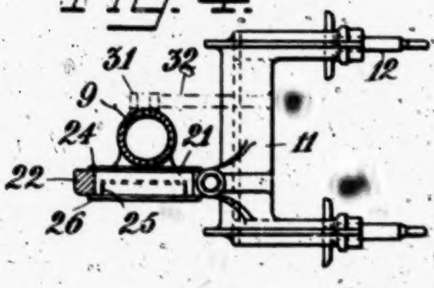


Fig. 7.

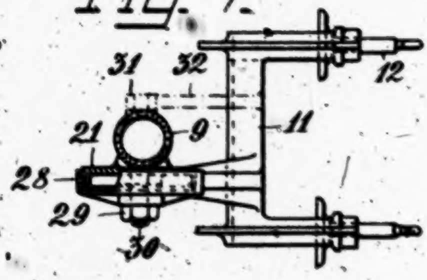
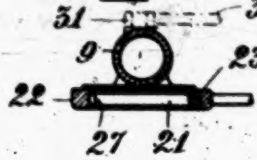


Fig. 5.



Witnesses

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Carl Ulrik Hult
Oscar Walfrid Hult
by
their Attorney

UNITED STATES PATENT OFFICE.

CARL ALRIK HULT AND OSCAR WALFRID HULT, OF STOCKHOLM, SWEDEN.

OUTBOARD MOTOR.

1,146,427. Specification of Letters Patent. Patented July 13, 1915.

Application filed July 3, 1913. Serial No. 777,152.

To all whom it may concern:

Be it known that we, CARL ALRIK HULT and OSCAR WALFRID HULT, subjects of the King of Sweden, and residents of 1 Inedalsgatan, Stockholm, in the Kingdom of Sweden, engineers, have invented certain new and useful Improvements in Outboard Motors, of which the following is a specification, reference being made to the accompanying drawings.

Outboard motors constructed in accordance with the present invention are chiefly characterized by the fact that the motor can be turned around a vertical (or somewhat inclined) axis (*e. g.* the center line of the motor shaft). As a result of this arrangement the motor can be fixed to the boat in a simple and suitable manner and the steering device is materially simplified. A simple and suitable method of supporting the motor is to place the sleeve which, usually, surrounds the motor shaft (hereinafter called the "shaft sleeve") in a second sleeve (hereinafter called the "fixing sleeve"), which latter sleeve is pivotally connected with that part of the supporting device of the motor which is fixed to the boat, the shaft sleeve also being adjustable in the fixing sleeve. By this arrangement the propeller can in a simple manner be adjusted into the position desired independently of the various shapes and sizes of different boats at the stern.

Not merely the motor itself can be turned around a vertical (or somewhat inclined) axis, but parts appurtenant thereto, *e. g.* the battery for the ignition of the explosive charges or an equivalent device, the fuel tank, etc., are rotatable with the motor. In this manner the motor itself is more directly connected with its appurtenant parts, the entire installation is easily protected against rain and the like by means of a common casing, and all connections which might interfere with the turning of the motor are eliminated.

The invention is illustratively exemplified in the accompanying drawings, wherein—

Figure 1 is a front elevational view, with parts in section, of a motor embodying our invention. Fig. 2 is an end elevational view thereof; Fig. 3 is an elevational view of modified means for securing the motor to a boat; Fig. 4 is a top plan view, with parts in section, of the construction illustrated in Fig. 3; Fig. 5 is a similar view to Fig. 4 of modified means for retaining the fixing sleeve in position; Fig. 6 is an elevational view of a still further modified form of means for securing the motor to a boat; Fig. 7 is a top plan view, with parts in section, of the construction illustrated in Fig. 6; Fig. 8 is an elevational view, with a part in section, of means for counteracting the tendency of the propeller to turn the tiller; Fig. 9 is a horizontal sectional view on the line A—B of Fig. 8; Fig. 10 is an elevational view, with a part in section, of a modified form of the structure shown in Fig. 8; Fig. 11 is an elevational view, with a part in section, of a still further modified form of the structure shown in Fig. 8; Fig. 12 is an elevational view, partly in section, and Fig. 13 is a vertical sectional view, of the motor shaft and propeller shaft and a form of gearing therebetween.

The motor shown by way of example is a one-cylinder motor. The motor cylinder 1 is fixed to one end of the crank casing 2 of the motor, at the other end of which crank casing is fixed a box 3, containing the electric ignition device (cells 4 and parts appertaining thereto).

The motor and the ignition device are covered and surrounded by a hood 6 fixed to the motor and thus participating in its turning. The roof of this hood carries a starting device. In the hood 6 there is also the benzin tank 7 likewise turning with the motor.

In outboard motors now in use the starting handle placed on the fly wheel of the motor, rotates at a high speed, when the motor is running, involving danger to persons and property. In order to obviate this danger the handle 36 is fixed to a part or disk 38, rotatable concentrically with the fly wheel 37 of the motor (or other part rotating with the motor shaft), said part or disk running in a circular path 40 fixed on the hood 6. The starting handle 36 is mounted on the disk 38 in such a manner that it can be moved toward the fly wheel 37, but is automatically (by a spring 41) carried back, when it is no longer being acted upon. The fly wheel is provided with one or more holes, into which the tapering end of the handle spindle 36ª fits. When the motor is to be started, the handle is pressed downward, the spindle 36ª then passing into the hole, or one of the holes, of the fly wheel. Then the disk 38 is revolved, so that the motor is set in motion, whereupon the handle 36 is left

free, so that it is carried back actuated by the spring 41, and immediately afterward the freely running disk 38 stops of its own accord.

As in other outboard motors there depends from the crank casing 2 a sleeve 8 (the shaft sleeve) surrounding the motor shaft. In outboard motors constructed in accordance with this invention, the shaft sleeve 8 is surrounded by a sleeve 9 (the fixing sleeve), which is pivotally connected with that part of the supporting device which is fixed to the boat, besides which the shaft sleeve can be adjusted at different heights in the fixing sleeve. By means of this arrangement a motor can be attached to boats of a great variety of sizes and shapes at the stern.

In the device illustrated in Figs. 1 and 2 the fixing sleeve 9 surrounding the motor sleeve 8 is by means of a pivot 10 pivotally connected with a bow piece 11, which is fixed to the boat by means of clamping screws 12. When the fixing sleeve has been adjusted relatively to the bow piece 11 fixed to the boat, so that the motor shaft is vertical, the said fixing sleeve is locked in its position in a suitable manner, *e. g.* by tightening a wing nut 13 placed on a bolt 14 provided with a head, which bolt 14 is mounted in a projection 15 on the bow piece 11 and passes through curved grooves 16 in projections or ears 17 on the fixing sleeve and embracing the projection 15. At the upper end of the fixing sleeve 9 rests a clamping ring or bow 18, by means of which the propeller is held at the desired height. By loosening and again tightening the screw bolt 19 passing through the ends of the clamping bow 18, the said clamping bow can be placed at a desired place on the shaft sleeve, and thus the height of the propeller can be adjusted according to the height of the stern of the boat. In the arrangement shown in Figs. 1 and 2, the tiller 20 is fixed to the crank casing 2.

In the modified form of invention shown in Figs. 3 and 4 the fixing sleeve 9 is placed at one side of a ring or disk 21, which is embraced by a clamping bow 22 placed on the bow piece 11, said clamping bow 22 being tightened around the disk by means of a screw bolt 23, so that the disk is locked in the position into which it has been adjusted. In order to retain the disk 21 in the clamping bow 22, even when the bow is not tightened around the disk, the latter is provided with a flange 24 resting against one side of the clamping bow, and there is also screwed into the disk a ring or disk 25, provided with a flange 26, which rests against the other side of the clamping bow. As shown in Fig. 3, the tiller 20 may be fixed in the clamping bow 18.

The arrangement shown in Fig. 5 differs from the arrangement just described with reference to Figs. 3 and 4, merely in the fact that the disk 21 is provided on its circumference with a groove 27, into which enters the bolt 23, thereby preventing the disk from leaving the clamping bow, when the latter has been loosened. Instead of consisting of a single springy part, the clamping bow 22 may consist of two parts, pivotally connected with one another.

In the arrangement shown in Figs. 6 and 7 the clamping bow 22 is replaced by a ring or disk 28, likewise mounted on the bow piece 11, the ring or disk 28 having an inwardly directed conical surface, against which the correspondingly formed circumference of the ring or disk 21 is held steadily pressed, *e. g.* by means of a nut 29 resting against the disk 28 and mounted on a threaded pin 30 which is fixed in the disk 21.

As is shown by dotted lines in Figs. 4, 5 and 7, the fixing sleeve 9—if this is considered necessary in order to obtain greater strength and steadiness—may on its side turned away from the ring or disk 21 be provided with a pivot 31, journaled in an arm 32 extending from the bow piece 11.

As is known, a propeller tends to turn its shaft, or a rudder connected with it, out of the direction which the propeller shaft or rudder ought to occupy for steering a certain course. In order to obviate, more or less, this drawback, so that the steersman is, in a greater or less degree relieved of the inconvenience caused by the said tendency, a checking or braking device can be placed between the part acted on in the steering and a part fixed relatively to the boat. Figs. 8 to 11 show different forms of a device for this purpose. According to Fig. 8 the tiller 20 (tiller is here understood to mean the rod or equivalent part which is acted upon in the steering, whether the latter is effected by means of a rudder or by means of the propeller, or both) fixed in the clamping bow 18 is surrounded by a sleeve 42, carrying a brake shoe 43, which coöperates with a brake path 44 arranged on the fixing sleeve 9. The tiller is surrounded by a spiral spring 45, which presses the brake shoe against the brake path.

In the arrangement indicated in Fig. 10, the tiller 20 is pivotally fixed to the clamping bow 18, so that the brake shoe 43 is pressed against the brake path by pressing the tiller downward.

The arrangement shown in Fig. 11 is a modification of the arrangement indicated in Fig. 8 in so far as the spring 45 is replaced by a nut 46, with the aid of which the brake shoe 43 is pressed more or less hard against the brake path 44.

In Figs. 12 and 13 is shown a form of gearing between the motor shaft or an extension of the same and the propeller shaft. This arrangement, which is suitable particu-

larly in cases where the motor shaft rotates with a speed which must be reduced in transmitting to the propeller shaft, consists therein that the motor shaft (or its extension) below forms, or is provided with, a worm 33, which engages with a worm wheel 35 mounted on the propeller shaft.

Although the present invention is shown applied to a one-cylinder motor, it can obviously also be applied to motors with two or more cylinders.

Having now described our invention, what we claim as new and desire to secure by Letters Patent is:

1. In a device of the class described, the combination of a boat, a motor therefor having an extended motor shaft and a sleeve inclosing said shaft, a second sleeve in which said first named sleeve and the parts appurtenant thereto are longitudinally adjustable, a substantially annular clamping ring, encircling said first named sleeve and movable along the same, said clamping ring being adapted to abut said second named sleeve and retain the first named sleeve and its appurtenant parts in longitudinally adjusted position, a clamp attachable to said boat, a connection between said clamp and said second named sleeve whereby the angular relation of said parts may be adjusted, means whereby said parts may be locked in adjusted position, and a tiller operatively connected to said clamping ring.

2. In a device of the class described, the combination of a boat, a motor therefor having an extended motor shaft and a sleeve inclosing said shaft, a second sleeve in which said first named sleeve and the parts appurtenant thereto are longitudinally adjustable, a substantially annular clamping ring encircling said first named sleeve and movable along the same, said clamping ring being adapted to abut said second named sleeve and retain the first named sleeve and its appurtenant parts in longitudinally adjusted position, a clamp attachable to said boat, a connection between said clamp and said second named sleeve whereby the angular relation of said parts may be adjusted, means whereby said parts may be locked in adjusted position, a tiller operatively connected to said clamping ring, and means for braking the action of said tiller.

3. In a device of the class described, the combination of a boat, a motor therefor having an extended motor shaft and a sleeve inclosing said shaft, a second sleeve in which said first named sleeve and the parts appurtenant thereto are longitudinally adjustable, a substantially annular clamping ring encircling said first named sleeve and movable along the same, said clamping ring being adapted to abut said second named sleeve and retain the first named sleeve and its appurtenant parts in longitudinally adjusted position, a clamp attachable to said boat, a connection between said clamp and said second named sleeve whereby the angular relation of said parts may be adjusted, means whereby said parts may be locked in adjusted position, a tiller operatively connected to said clamping ring, and means for braking the action of said tiller, said last named means including a brake shoe carried by said tiller and a brake path engaged by said shoe.

4. In a device of the character described, the combination of a boat, a motor therefor provided with a fly wheel, means whereby said motor may be vertically adjusted in relation to said boat, means whereby the angular relation of said motor to said boat may be adjusted, a loosely revoluble disk concentric with said fly wheel, and a yieldingly mounted starting handle carried by said disk and adapted to releasably connect the latter to the fly wheel.

In witness whereof we have hereunto set our hands in presence of two witnesses.

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OSCAR WALFRID HULT.

Witnesses:
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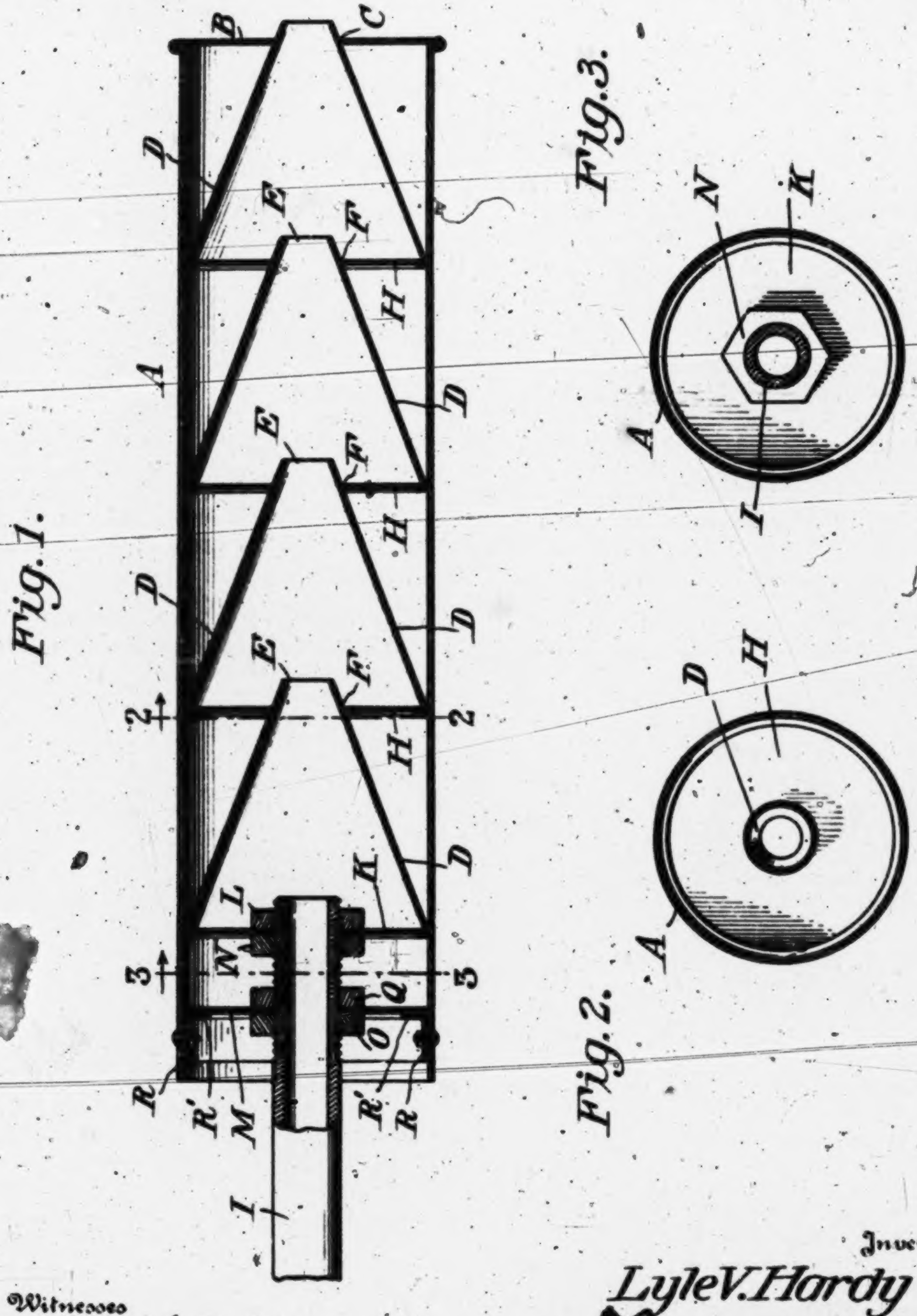
H. S. OHLSSEN.

414

L. V. HARDY.
SILENCING MUFFLER.
APPLICATION FILED MAR. 23, 1915.

1,169,030. Patented Jan. 18, 1916.



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SILENCING-MUFFLER.

1,169,030. Specification of Letters Patent. Patented Jan. 18, 1916.

Application filed March 23, 1915. Serial No. 16,359.

To all whom it may concern:

Be it known that I, LYLE V. HARDY, a citizen of the United States, residing at Lowville, in the county of Lewis and State of New York, have invented certain new and useful Improvements in Silencing-Mufflers; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

This invention relates to new and useful improvements in mufflers for engines and consists in the provision of a silencer of this nature whereby the possibility of back pressure and after firing are eliminated and by which an economy in fuel is afforded.

My invention consists essentially in the provision of a muffler having a series of conical-shaped members, the open apex end of each extending centrally through an opening in the base of the next adjoining member and forming a continuous passageway through the series of reversely arranged megaphones.

My invention consists of various other details of construction, combinations and arrangements of parts which will be hereinafter fully described, shown in the accompanying drawings and then specifically defined in the appended claims.

I illustrate my invention in the accompanying drawings, in which:

Figure 1 is a central longitudinal sectional view through the muffler. Fig. 2 is a sectional view on line 2—2 of Fig. 1. Fig. 3 is a sectional view on line 3—3 of Fig. 1.

Reference now being had to the details of the drawings by letter, A designates a cylindrical muffler having an end B with a central opening C, the marginal edge of said end being bent over the flanged end of the muffler and securely fastened thereto. Within the shell of the muffler is a series of conical-shaped members, each designated by letter D, each having an open apex E extending through an aperture F in the bottom H of the member, the series being held in place by means of the pipe I which passes through registering apertures in the bottom K of the outermost of the several conical-shaped members and also through an apertured disk M. Lock nuts N and L are mounted upon the exhaust pipe I, one upon either side of the bottom K, and similar nuts O and Q are mounted upon the pipe, one upon either side of the disk or end M. A flanged collar R is bolted or otherwise secured within the shell of the muffler and its angled portion, designated by letter R′, is adapted to bear against the outer face of the disk or end M, thus forming a secure means for holding the various conical-shaped members in place with the pipe I in alinement with the several apertures through the apex of each member.

By the provision of a silencing muffler made in accordance with my invention on the principle of a series of reversed megaphones, I have found that after firing is avoided, a great saving of fuel effected and dispensing with the noise usually accompanying the opening of the cut out in climbing hills and, owing to the direct passage of the gas, its course is prevented from spreading and which tends to decrease the velocity of the gas, whereas, in the operation of mufflers in which the reverse arrangement of megaphone-shaped members is employed, the gases are allowed to spread and necessarily retard their exit.

What I claim to be new is:—

1. A silencing muffler comprising a shell having a series of conical-shaped members mounted therein, each having an apex opening and a central aperture in its closed bottom, the open apex end of each member extending through an aperture in the bottom of an adjacent member, an exhaust pipe fastened in an aperture in the bottom of the end of the series of members and in alinement with the openings through the apices of said members.

2. A silencing muffler comprising a shell having a series of conical-shaped members mounted therein, each having an apex opening and a central aperture in its closed bottom, the open apex end of each member extending through an aperture in the bottom of an adjacent member, an apertured disk within the muffler, an exhaust pipe passing through the aperture of said disk and an opening in the bottom of the adjacent conical-shaped member, and means for fastening the pipe to said disk and apertured bottom.

3. A silencing muffler comprising a shell having a series of conical-shaped members mounted therein, each having an apex opening and a central aperture in its closed bottom, the open apex end of each member ex-

tending through an aperture in the bottom of an adjacent member, an apertured disk within the muffler, a circumferentially threaded exhaust pipe passing through the aperture of said disk and an opening in the bottom of the adjacent conical-shaped member, lock nuts mounted upon the pipe and engaging the apertured disk and bottom of the adjacent member, and means for holding the disk within the shell.

4. A silencing muffler comprising a shell having a series of conical-shaped members mounted therein, each having an apex opening and a central aperture in its closed bottom, the open apex end of each member extending through an aperture in the bottom of an adjacent member, an apertured disk within the muffler, a circumferentially apertured pipe passing through the aperture of said disk and an opening in the bottom of the adjacent conical-shaped member, lock nuts mounted upon the pipe and engaging the apertured disk and bottom of the adjacent member, and a collar fitted within the shell and holding the disk in place.

5. A silencing muffler comprising a shell having a centrally apertured end, a series of conical-shaped members, each having an open apex extending through the bottom of a central aperture in the bottom of an adjacent member, the apex of the end member of the series extending through the aperture in the end of the shell and the marginal edges of the members frictionally engaging the inner surface of the shell, an apertured disk within the shell in registration with the openings in the bottoms of the members, a threaded pipe passing through said disk and the aperture in the bottom of the adjacent member, lock nuts mounted upon the pipe and engaging said disk and bottom of the adjacent member, and a flanged collar fastened within the shell and bearing against said disk.

In testimony whereof I hereunto affix my signature in presence of two witnesses.

LYLE V. HARDY.

Witnesses:

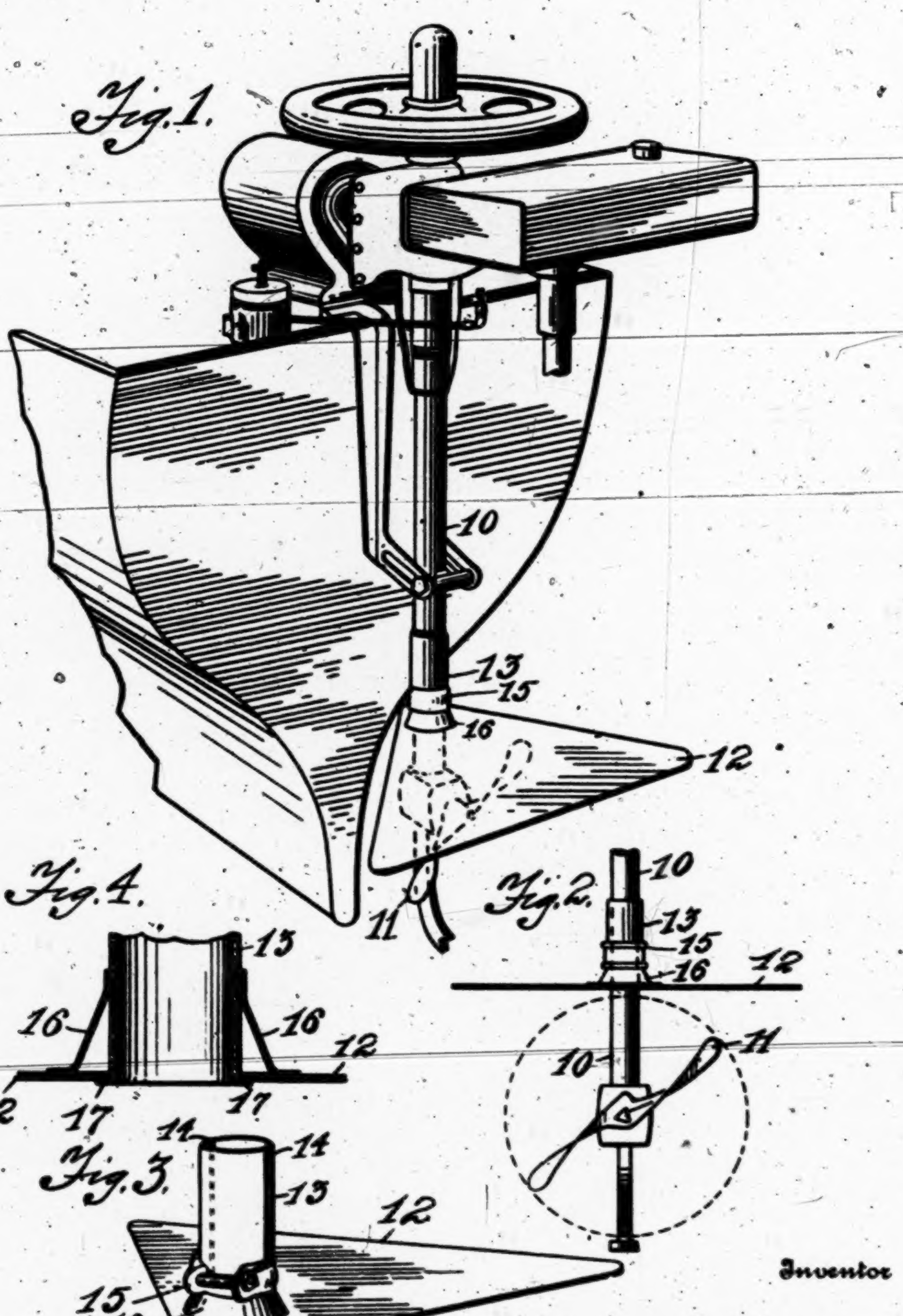
JOHN A. MITCHELL,
CHAS. MULLIN.

S. A. SMITH.

BAFFLE PLATE FOR PROPELLER WHEELS.

APPLICATION FILED SEPT. 9, 1916.

1,226,400. Patented May 15, 1917.



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UNITED STATES PATENT OFFICE.

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BAFFLE-PLATE FOR PROPELLER-WHEELS.

1,226,400. Specification of Letters Patent. Patented May 15, 1917.

Application filed September 9, 1916. Serial No. 119,275.

To all whom it may concern:

Be it known that I, SIDNEY A. SMITH, a citizen of the United States, residing at the city of Jamestown, in the county of Chautauqua and State of New York, have invented certain new and useful Improvements in Baffle-Plates for Propeller-Wheels, of which the following, taken in connection with the accompanying drawings, is a specification.

The invention relates to improvements in devices for aiding in the action of propeller wheels for out-board motors for propelling boats and particularly in shallow or rough water where they are liable to take air and race or run wild; and the improvement consists in providing a flat baffle plate immediately above the propeller wheel of sufficient width to cover the wheel, yet which being edgewise toward the direction of motion of the vessel does not retard the forward movement of the boat. All users of motor boats are aware that in shallow water when the propeller rises partly out of or too near the surface of the water and in rough water whenever the propeller is nearly or partially uncovered the propeller will race or run wild, not getting a grip on the water. By the provision of a baffle plate immediately above the propeller it is apparent that it can rise much nearer the surface of the water thereby permitting the boat to run in much shallower water than would otherwise be possible; and the invention consists in the novel features and combinations hereinafter set forth and claimed.

In the drawings, Figure 1 is a perspective view of an out-board motor with the improved baffle plate on the propeller drive shaft casing above the wheel, a portion of the propeller wheel being shown in dotted outline beneath said plate. Fig. 2 is a rear elevation of the propeller wheel and the baffle plate in position above the same, the circle described by the blade of the wheel being shown in dotted line. Fig. 3 is a perspective view of the baffle plate. Fig. 4 is a fragmentary vertical sectional view of the baffle plate.

Like characters of reference refer to corresponding parts in the several views.

The numeral 10 designates the tube or casing inclosing the propeller drive shaft, and the numeral 11 the propeller wheel which is attached to the shaft in any suitable manner for turning the propeller wheel 11.

The baffle plate 12 consists preferably of a thin flat triangular-shaped plate of sufficient thickness to hold stiffly above the propeller wheel 11, one of the sides of the triangle being placed to the rear so that the plate 12 points toward the front and cuts its way edgewise through the water as it advances. In order to hold the plate 12 in the horizontal position in relation to the tube or casing 10 and cover the wheel 11, a tubular extension 13 is attached to the plate 12 near the front point and is preferably split at 14 to permit the clamping of the tube 13 upon the casing 10 by means of the screw band clamp 15.

In order to firmly brace the baffle plate 12 in the horizontal position, a bracing or angular fillet strip 16 is attached at its upper end around the tube 13 by welding or soldering the lower edge of the fillet 16 to the baffle plate 12 at a spaced distance from the tube 13 thereby bracing said tube 13 all around its lower end attachment to the baffle plate 12. The lower end of the tube 13 is preferably turned outward in a circular flange 17 around said lower end. A round hole is made in baffle plate 12 for inserting the tube 13.

When so constructed and braced, it is apparent that the baffle plate 12 can be slipped onto the casing 10 and placed at any desired point thereon in spaced relation above the propeller wheel 11, preferably as close to said propeller wheel as permissible and avoid touching the same when rotated, and, being flat, the baffle plate 12 will cut through the water without appreciable effect upon the speed of the boat, yet permitting the propeller on an out-board motor to be raised so that said boat can run into shallow inlets and in other shallow waters where it could not run without said baffle plate above the propeller.

I claim as new:

1. A baffle plate for propeller wheels having a vertical incased drive comprising a flat plate, and means for removably and adjustably supporting said plate in a horizontal position from the shaft casing and over the propeller wheel to cut edgewise through the water.

2. A baffle plate for propeller wheels comprising a triangular shaped plate and means

for supporting said three-cornered plate with one of said points to the front and the wide rear portion a spaced distance above the propeller wheel to prevent taking air when said wheel is rotating near the surface of the water.

3. A baffle plate for propeller wheels comprising a flat metal plate, a split tube attached to said plate for attachment to a support to hold said plate a spaced distance above the propeller wheel, and a clamp for said tube for fixedly securing the latter to said support.

4. The combination with a propeller drive shaft casing and wheel of an out-board motor, of a flat triangular shaped plate, a split tube attached near the front point of said triangular plate, a screw band clamp to attach said split tube on said casing and hold said plate horizontally a spaced distance above said propeller wheel to prevent said wheel taking air in shallow water.

5. A baffle plate for propeller shafts composed of a flat perforated plate member, a vertical support received in the perforation of the plate, and means to adjustably lock the plate to said support.

6. A baffle plate for outboard motor propellers composed of a plate member formed to engage over the propeller drive shaft casing, and means to removably clamp the plate to said casing in overlying relation to the propeller.

7. A baffle plate for motor propellers composed of a perforated plate member, a sleeve passed through the perforation of said member and having its end adjacent the latter flanged outwardly to seat against the normal under face of the plate, means associated with the sleeve to secure same in position to a suitable support and bracing means connected to the sleeve and to the normal upper face of the plate member.

In testimony whereof I have affixed my signature in the presence of two witnesses.

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422

1,234,293.

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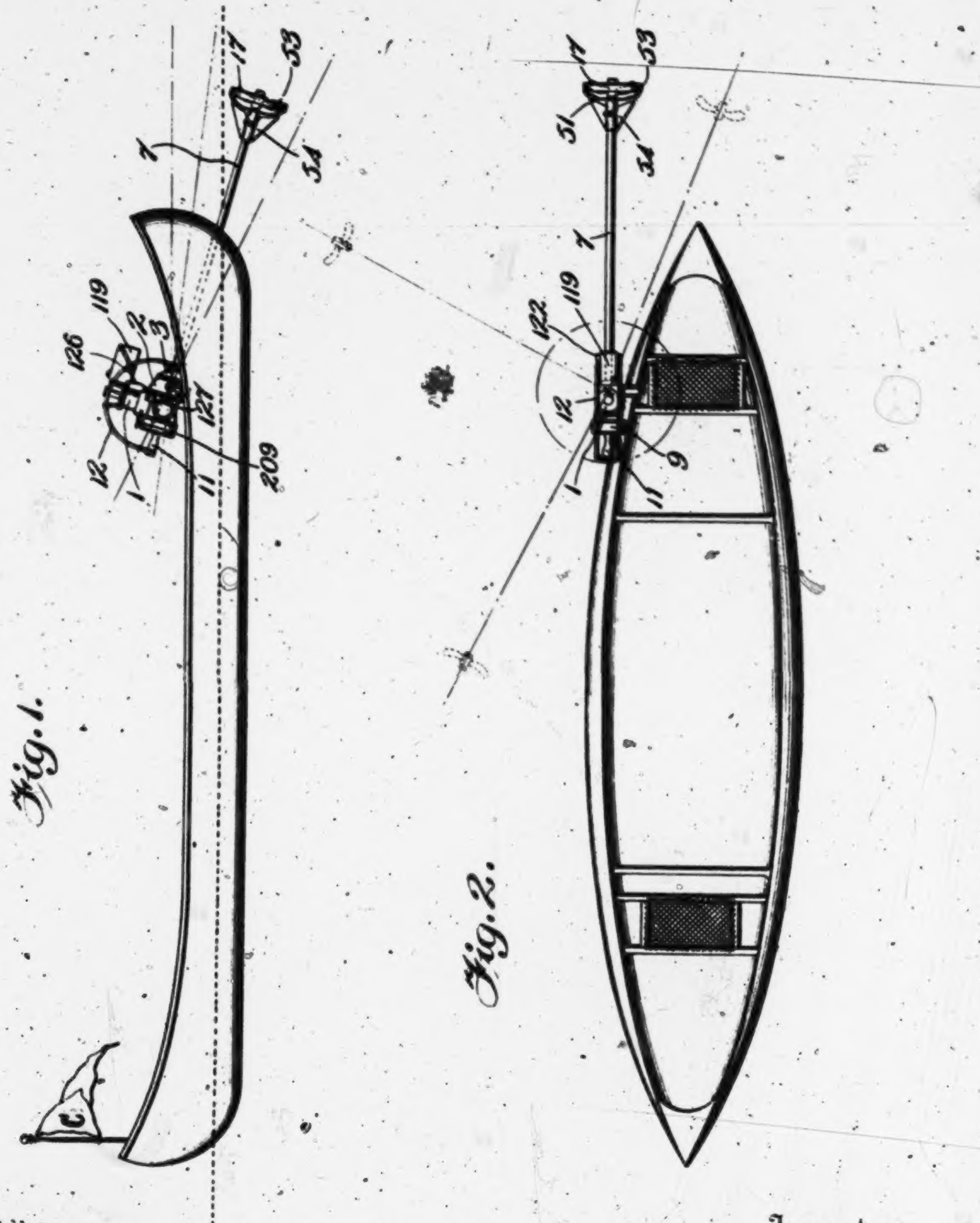
MOTOR OAR.
APPLICATION FILED AUG. 26, 1912.

Patented July 24, 1917.
7 SHEETS—SHEET 1.



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MOTOR CAR.

APPLICATION FILED AUG. 26, 1912.

1,234,293.

Patented July 24, 1917.

7 SHEETS—SHEET 2.

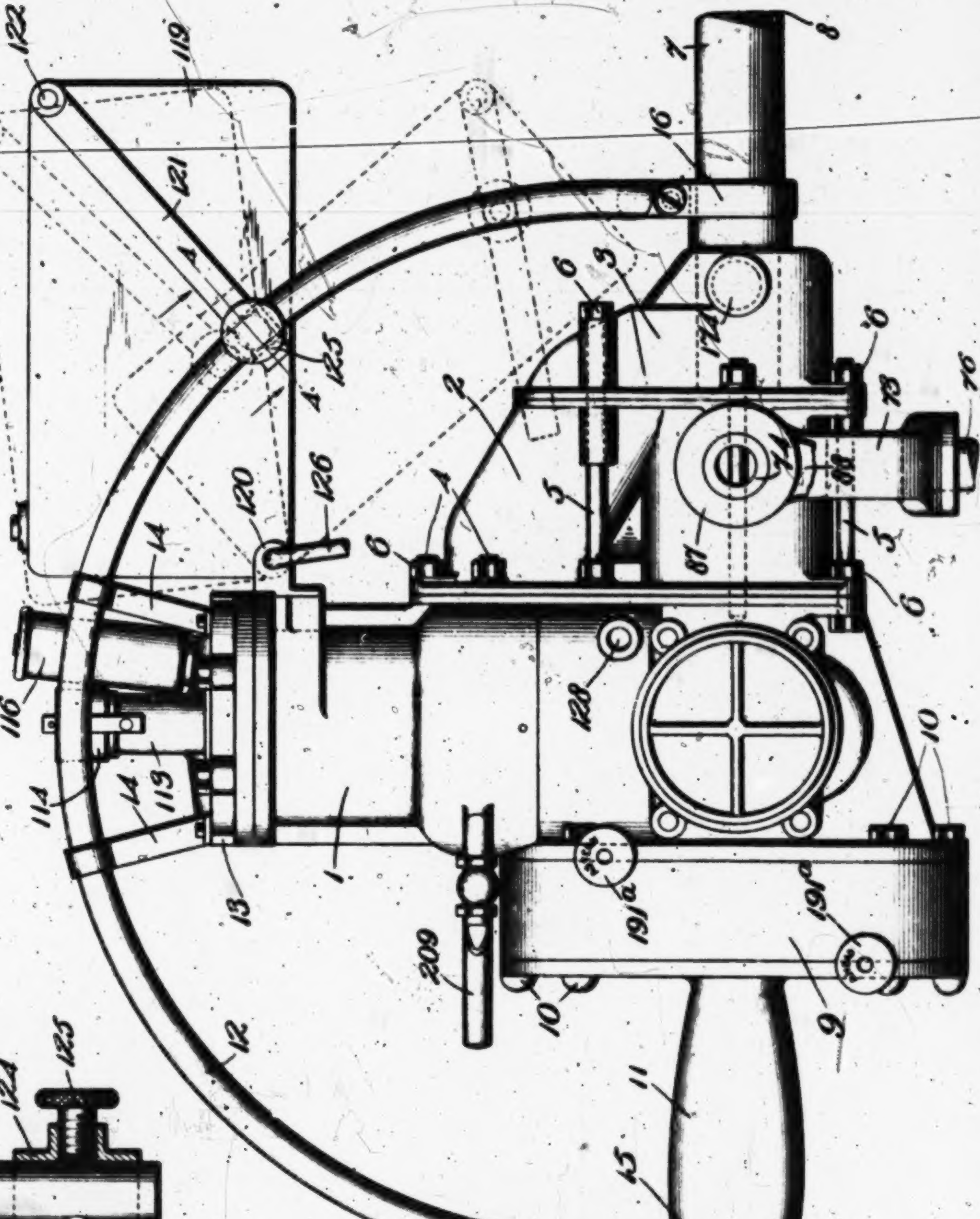

Fig. 3.

Fig. 4.

Witnesses

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1,234,293.

Patented July 24, 1917.

7 SHEETS—SHEET 3.

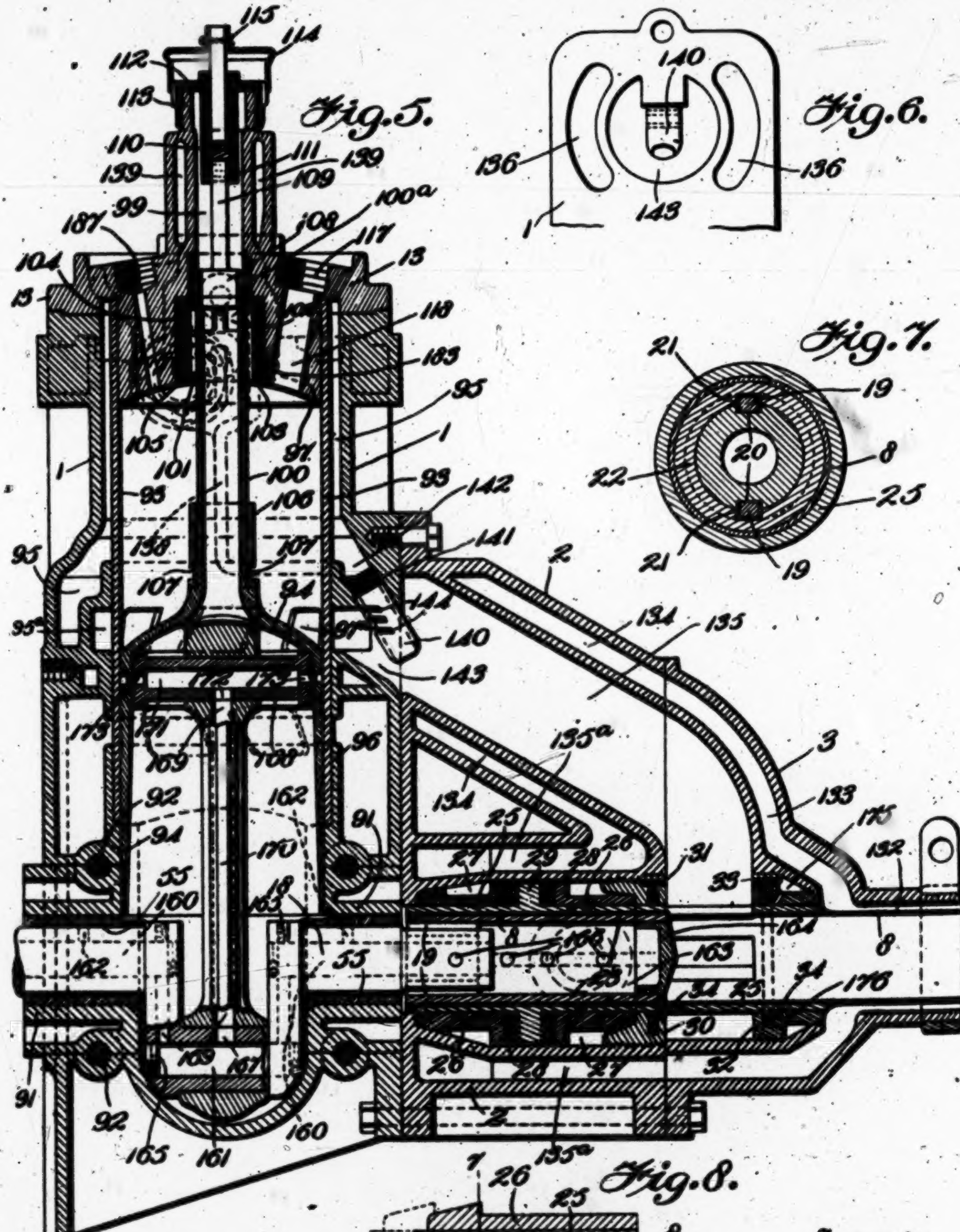

Fig. 5.

Fig. 6.

Fig. 7.

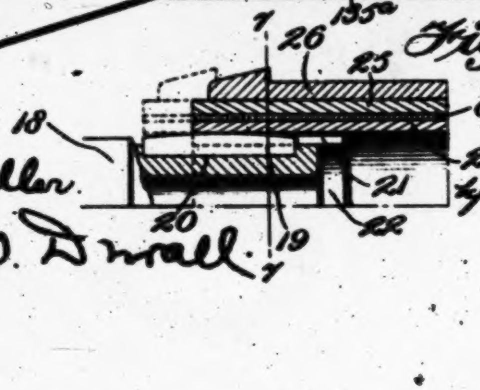

Fig. 8.

Witnesses

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APPLICATION FILED AUG. 26, 1912.

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7 SHEETS—SHEET 4.

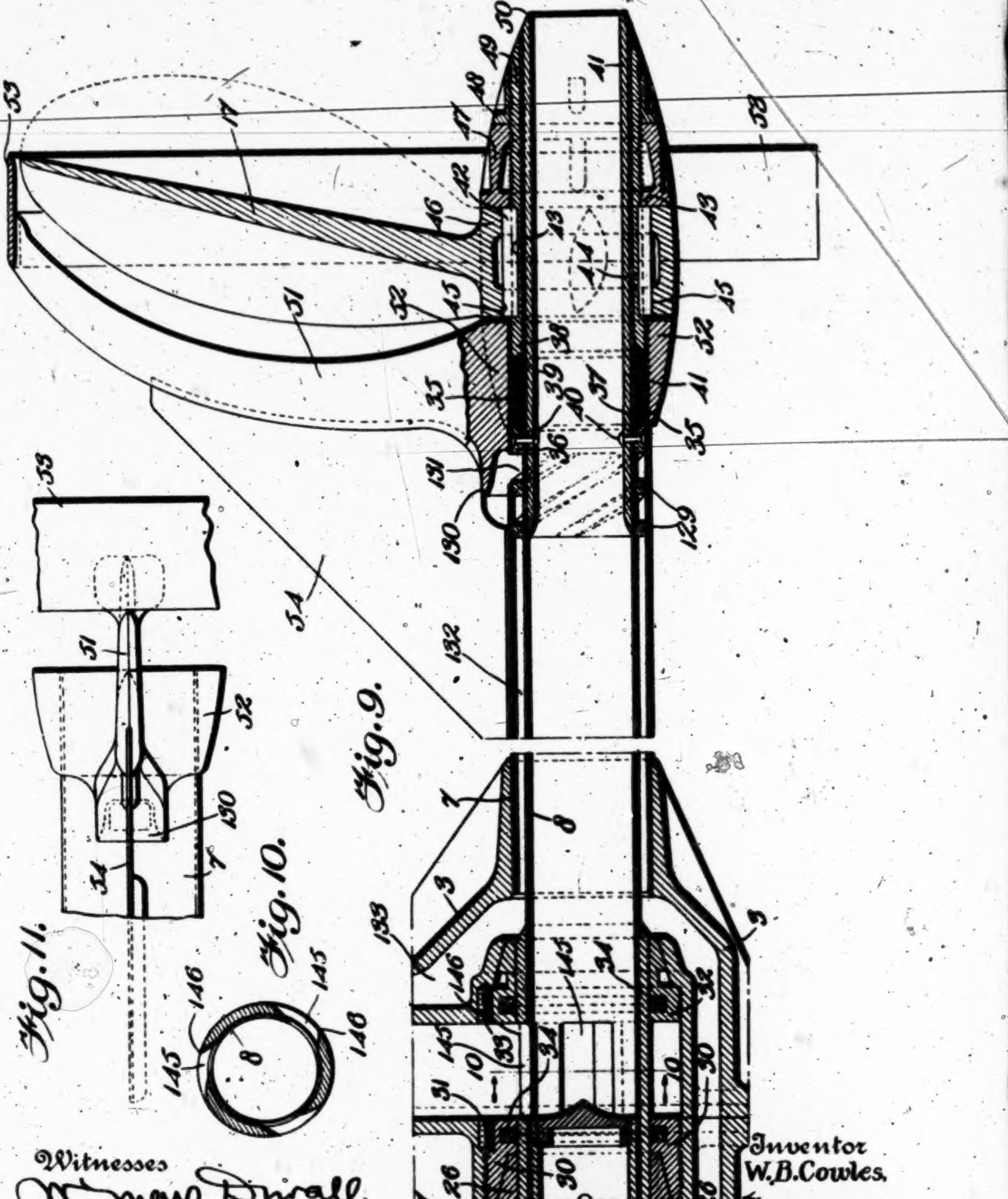

Fig. 9.

Fig. 10.

Fig. 11.

Witnesses

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By [illegible]

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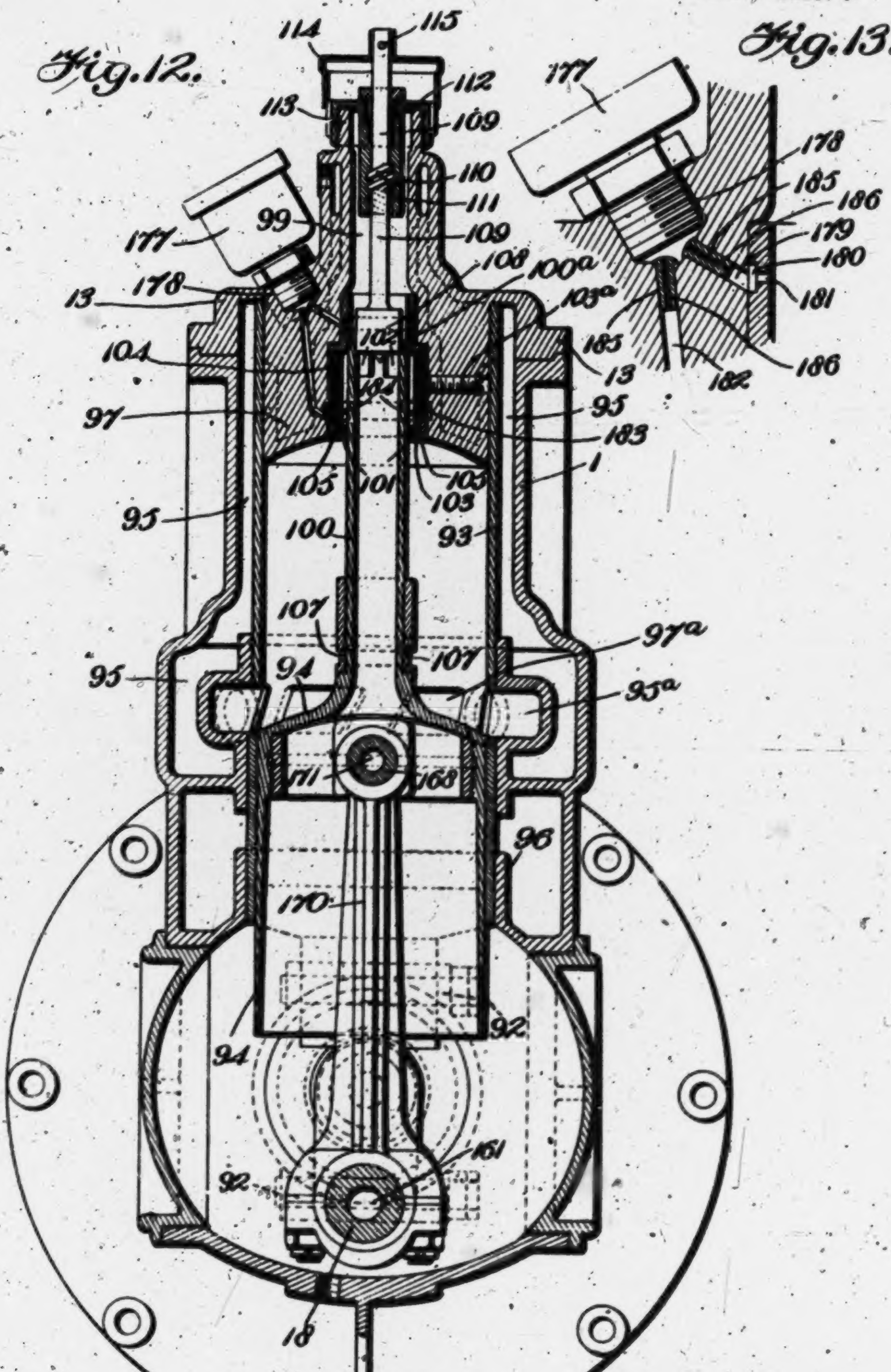
APPLICATION FILED AUG. 26, 1912.

1,234,293.

Patented July 24, 1917.

7 SHEETS—SHEET 5.



Witnesses

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APPLICATION FILED AUG. 26, 1912.

1,234,293.

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7 SHEETS—SHEET 6.

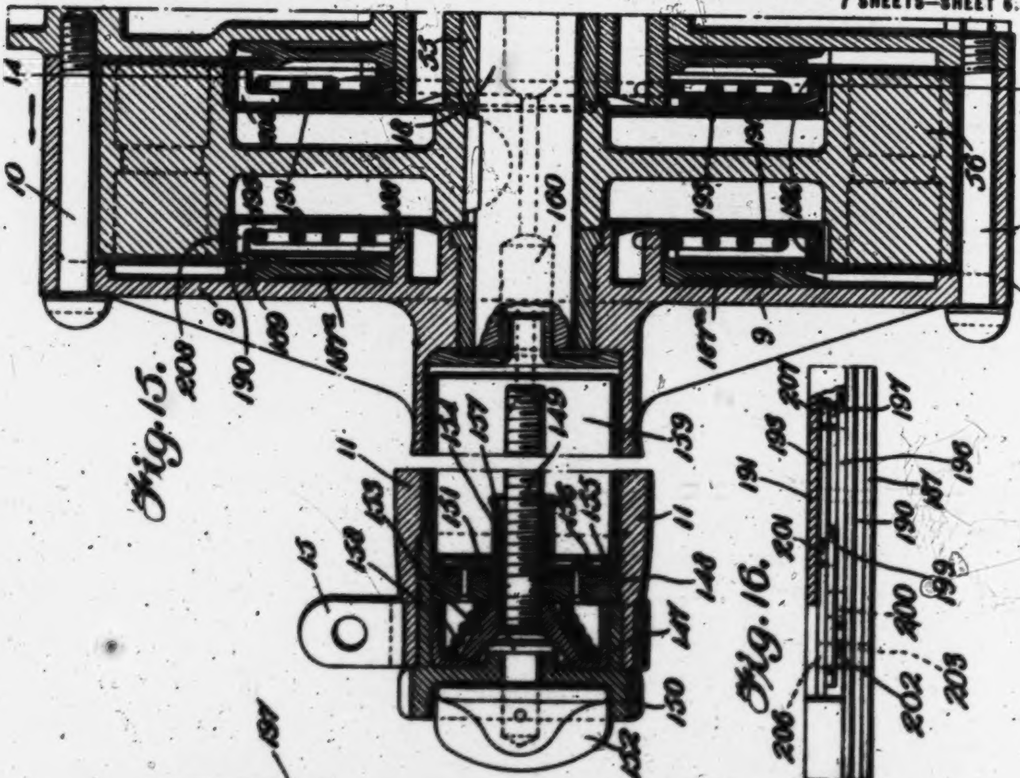

Fig. 15.

Fig. 16.

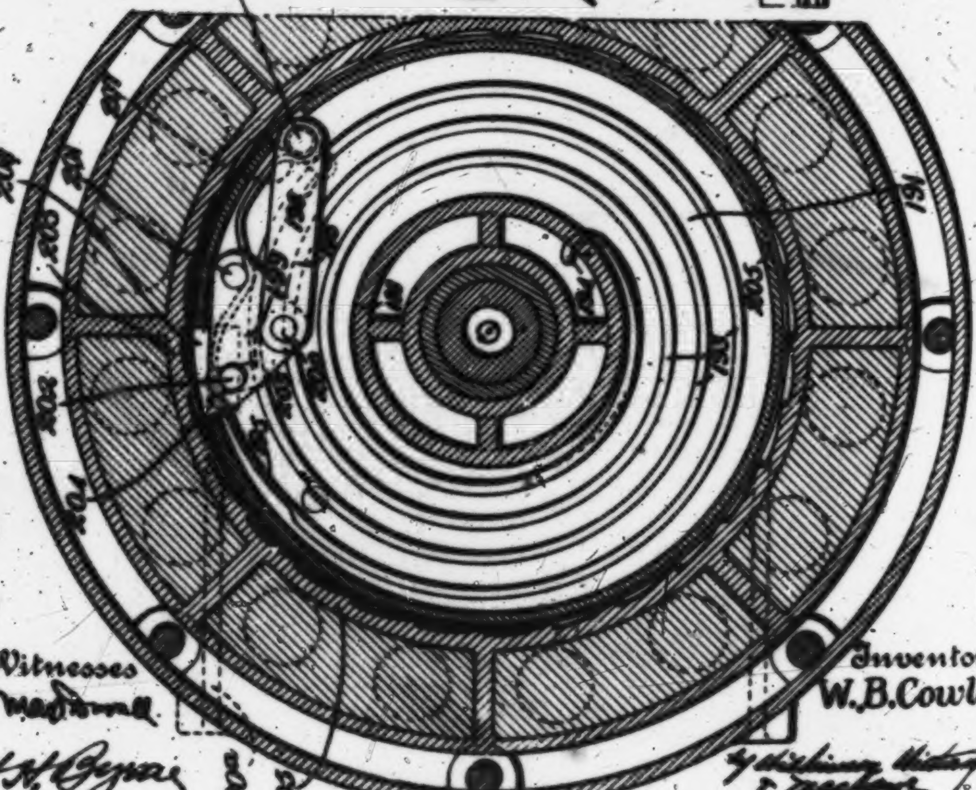

Fig. 14.

Witnesses
[illegible]
[illegible]

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1,234,293.

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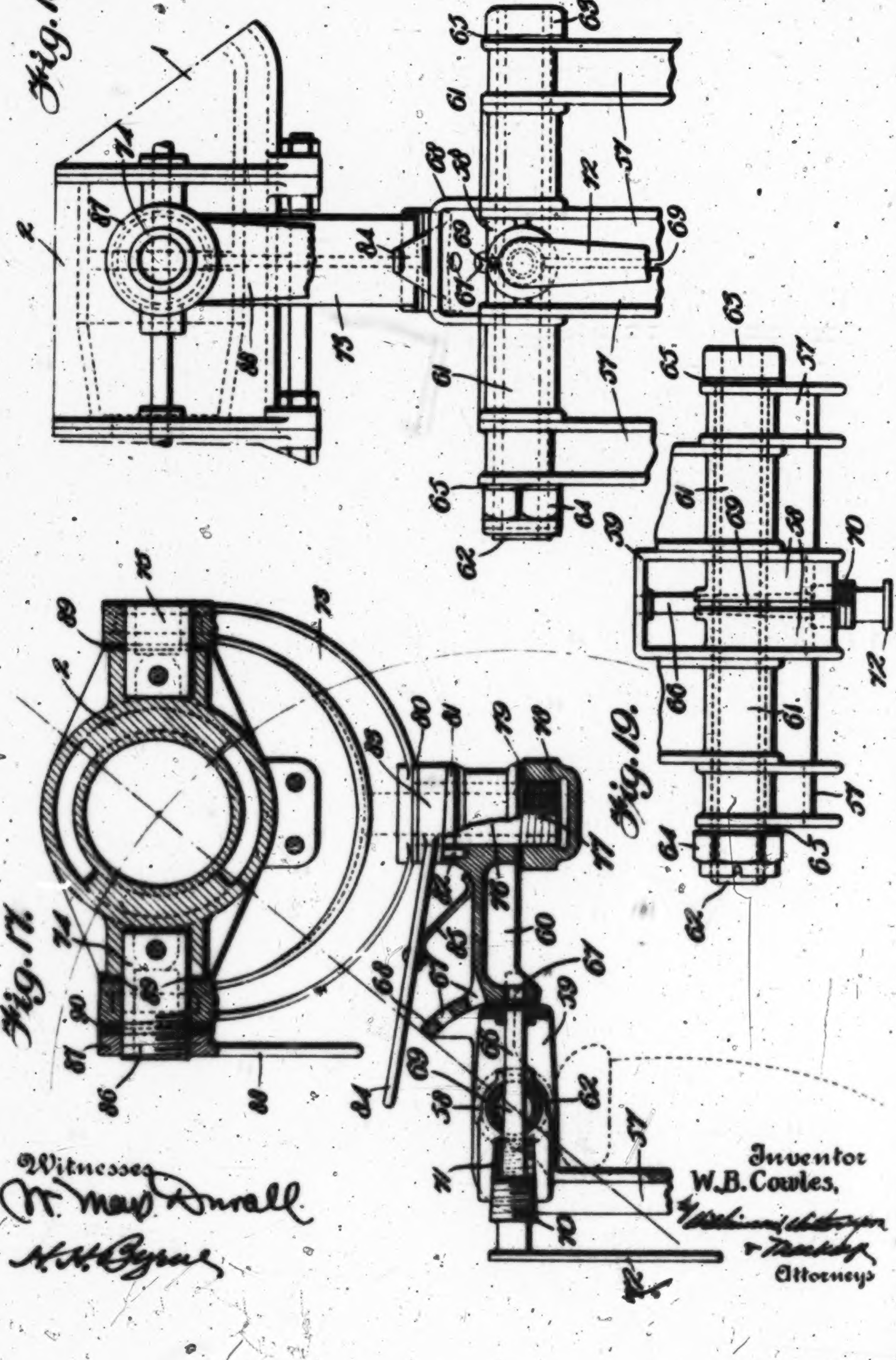
APPLICATION FILED AUG. 26, 1912.

Patented July 24, 1917.

7 SHEETS—SHEET 7.



Witnesses

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by
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UNITED STATES PATENT OFFICE.

WILLIAM BARNUM COWLES, OF CLEVELAND, OHIO.

MOTOR-OAR.

1,234,293. Specification of Letters Patent. Patented July 24, 1917.

Application filed August 26, 1912. Serial No. 717,149.

To all whom it may concern:

Be it known that I, WILLIAM BARNUM COWLES, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Motor-Oars; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The present invention relates to motor oars for small craft, especially canoes, and consists in the combinations and arrangements of parts hereinafter disclosed and particularly set forth in the claims.

The invention has for its purpose to provide a motor oar having the several elements thereof arranged in alinement and in a compact and readily portable unit which is capable of being mounted at different places on the boat, all to the end of convenience for controlling the motor, deriving the maximum efficiency from the propeller, and ease in maneuvering the craft.

The invention further proposes a motor oar which employs an explosive engine as the motive power wherein the starting thereof is effected by a simple and manually actuated device associated with the fly-wheel; wherein the initial and subsequent firings in the cylinder are effected by super-compression of the explosive charges; and wherein the fuel supply system is automatically operable to indicate at periods the amount of fuel on hand.

Another object of the invention consists in maintaining a circulating water system for cooling the motor and shaft bearings, and treating the exhaust gases to reduce back pressure, through a pump and an exhaust turbine associated with the propeller shaft; and by utilizing the suction through said shaft incident to the cavitation produced by the propeller to accelerate the water circulation and further decrease the exhaust back pressure.

Referring to the accompanying drawings forming a part of this specification in which like numerals designate like parts in all the views:—

Figure 1 is a side elevational view of the motor oar mounted on a canoe;

Fig. 2 is a top plan view of the same;

Fig. 3 is a side elevational view of the forward assembly of the motor oar;

Fig. 4 is an enlarged detail sectional view taken on the line 4—4 of Fig. 3 of the clamp for adjustably securing the fuel tank;

Fig. 5 is a longitudinal sectional view, with parts in elevation, of the engine, and crank shaft and propeller shaft connection;

Fig. 6 is a front elevational view of a face of the engine casing showing the inlet to the cylinder water jacket and the outlet of exhaust;

Fig. 7 is a transverse sectional view of the engine crank shaft and propeller shaft connection taken on the line 7—7 of Fig. 8;

Fig. 8 is a longitudinal sectional view, with parts in elevation, of a detail of said shaft connection;

Fig. 9 is a longitudinal sectional view of the rear assembly of the motor oar;

Fig. 10 is a transverse sectional view of the exhaust turbine taken on the line 10—10 of Fig. 9;

Fig. 11 is an elevational view of a detail of the propeller guard and showing one of the water scoops;

Fig. 12 is a central sectional view of the engine taken at right angles to the view shown in Fig. 5;

Fig. 13 is an enlarged detail view partly in elevation and partly in section of the cylinder lubricator;

Fig. 14 is a transverse sectional view, taken on line 14—14 of Fig. 15 and looking in the direction of the arrows, of the engine starting devices;

Fig. 15 is a central sectional view thereof, and shows the force feed lubricator;

Fig. 16 is a top plan view of the engaging and releasing elements of the starting devices;

Fig. 17 is a rear elevational view, with parts in section, of the mount for the motor oar;

Fig. 18 is a side elevational view thereof; and

Fig. 19 is a top plan view of the same.

Referring to the construction in detail, the motor oar comprises (see Figs. 3 and 5) an explosive engine 1 having a supplemental casing of sections 2 and 3 secured to the engine cylinder and crank-shaft casings by bolts 4 and 5, and nuts 6. A sheath tube or shaft 7 for the propeller shaft 8 is se-

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cured to the casing section 3, and said sheath shaft is of substantially the length of the propeller shaft and provides the oar arm for maneuvering the craft. The engine fly-wheel casing 9 is secured by bolts 10 to the crank-shaft casing on the side opposite to the supplemental casing, and has a steering handle 11 mounted thereon in alinement with the maneuvering arm or sheath shaft 7; and a pair of light metal tubes 12 disposed on each side of the engine provide supports for said steering handle and the maneuvering arm and form guards for the motor accessories. Said guard tubes 12 are of semi-circular design and are secured to the cylinder head 13 by brackets 14 mounted on said head, and have their respective ends detachably connected to the steering handle 11 and the casing section 3 by clamping rings 15 and 16, respectively.

The propeller shaft 8 which is of tubular construction (see Fig. 9) has the propeller 17 mounted thereon, and is journaled at its respective ends in the sheath shaft 7 and the supplemental casing (2 and 3) and connects directly with the engine crank-shaft 18 (see Fig. 5) by a slightly flexible and keyed slip joint. Said connection consists (see Figs. 7 and 8) of a pair of keys 19 bedded within key-ways 20 formed in the end of the crank shaft, and fitting within key-ways 21 formed in the extra thickness 22 of an inner reinforcing sleeve 23 on the forward end of the tubular propeller shaft 8. Said keys are seated snugly in the recesses 20 of the crank-shaft and permit of the sleeve 23 of the propeller shaft being easily slipped on or off said keys through the sleeve key-ways 21, to couple or un-couple the propeller shaft and crank-shaft. The outer edges and both sides of the keys 19 are curved slightly toward each end which, by reason of the straight sides of the key-ways 21 of the sleeve 23, constitute a flexible joint for relieving the thrust and the propeller shaft bearings from the strains and effects of wear on the crank-shaft and its bearings.

The bearing for the forward end of the propeller shaft 8 (see Figs. 5 and 9) consists of an outer reinforcing sleeve 25 secured to said shaft and fitting within a journal box comprising a pair of thrust collars 26 seated within a chamber 27 of the casing section 2 and holding thrust rings 28 against either side of the annular flange 29 formed on said sleeve 25. Said thrust collars 26 are of substantially conical design and are held in position by a bushing 30 which screw threads into said casing section and is secured therein by a screw 31. A similar bushing 32 screw threads into the casing section 3, and is secured by a screw 33, and both of said bushings 30 and 32 are provided with felt washers or the like 34. The inner and outer reinforcing sleeves 23 and 25 are designed to be "sweated" or brazed on the propeller shaft when of bronze, or electrically welded when constructed of iron or steel; or they may be screwed or riveted on.

The stern bearing for the propeller shaft (see Fig. 9) consists of a Babbitt or lignum-vitæ sleeve 35 interposed between the shaft 8 and the sheath tube 7 just forward of the propeller 17, and is secured to said shaft 8 by a collar 36 having a beveled edge 37, and an outer shaft reinforcing sleeve, 38 having a similar beveled edge 39. Said collar 36 is secured to the propeller shaft 8 by rivets 40 which pass through said collar, the shaft 8, and the inner shaft reinforcing sleeve 41; and the propeller shaft reinforcing sleeves 38 and 41 are secured to the propeller shaft as in that manner stated of the shaft reinforcing sleeves 23 and 25.

The propoller 17 is mounted on the reinforcing sleeve 38 through the medium of keys 42 that fit within key-ways 43 formed in a reduced section 44 of said sleeve, and seat within similar key-ways 45 in the propeller hub 46. A pair of jam nuts 47 and 48 screwed on a threaded portion 49 of the sleeve 38 secure the propeller in keyed position on said sleeve. To remove the propeller it is necessary only to take off the jam nuts 47 and 48 and slip the propeller from off the keys 42, and to remove and renew the bearing sleeve 35, the rivets 40 of the collar 36 are cut and the collar slipped forward when a new bearing sleeve of lignum-vitæ or Babbitt metal is fitted on in halves, and the collar is then replaced and re-riveted.

The jam nuts 47 and 48 and the ends of the propeller hub and inner sleeve 41 together with the shaft 8, are designed with a curved and rearwardly extending taper to produce a fine edge 50 on the propeller shaft whereby the current in the wake of the propeller will cause suction through the propeller shaft for drawing out the exhaust products from the motor as will be further explained.

A propeller guard is mounted on the sheath shaft around the bearing sleeve 35, and comprises a spider legged structure 51 having a hub 52; a guard ring 53 secured to the spider legs, and a plurality of bracket plates or blades 54 secured to the sheath shaft and the spider legs. The guard is constructed of sheet, pressed, or cast metal for lightness and rigidity, and the several parts thereof are united by brazing or electric welding.

The crank-shaft 18 (see Figs. 5 and 15) is journaled in the bushings 55 in the crank-shaft casing, and the fly-wheel 56 is keyed on said crank-shaft in the fly-wheel casing 9, concentric with the steering handle 11

and the propeller and sheath shafts 8 and 7. The steering handle, the motor, and the maneuvering arm, with the propeller shaft and propeller are all disposed in alinement and are mounted as a balanced unit on a universal support adapted for attachment to the side, quarter or stern of the boat, and which permits of the oar having a sweep over an area of 180° for maneuvering, and a relatively great dip in the vertical plane for depth of immersion of the propeller and for quickly lifting the same entirely out of the water.

The oar support comprises a bracket 57 (see Figs. 17 to 19) adapted to be secured in any suitable manner in the boat and having a divided head 58, and a part 59 that projects over the boat rail in the manner shown. A bifurcated bracket arm 60, (see Fig. 17) adapted to swing out-board and in-board of the boat to position or remove the oar, has the members 61 thereof disposed between the bracket side members 57 and the divided head 58, and is mounted on a tubular bolt 62 carried by said bracket. The respective ends of said tubular bolt are provided with a head 63 and a screw-threaded nut 64, and a pair of spring washers 65 on the bolt are disposed between said head and nut and the bracket. The bracket arm is adapted to be secured at different positions when out-board to suit the distance of the rail above water, owing to the varying load on the boat, by means of a locking pin 66 designed to engage within the holes 67 formed in a curved plate section 68 on the bracket arm. Said locking pin has a tapered portion 69 passing through the tubular hinge bolt 62, and an enlarged screw threaded and tapered portion 70 adjustable within the tapered and screw-threaded recess 71 in the bracket head 58. When the locking pin is screwed by its handle 72 to enter the selected aperture 67 of the arm 60, the tapered portions 69 and 70 of the pin act to expand or spread the parts of the bracket head 58 which, with the bolt head 63, nut 64 and spring washers 65, grip or jam said parts against the hinged parts 61 of the bracket arm and hold said arm in place in the selected position of its swing.

A yoke 73 has journaled therein the trunnion pins 74 and 75 carried by the motor casing section 2 (see Figs. 3, 17 and 18) and said yoke is mounted on the bracket arm 60 to give the horizontal sweep to the oar by a swivel pin 76 fitting within an eye at the end of the yoke arm. In order to control the manipulation of the oar in the horizontal sweep the yoke swivel 76 has a threaded end 77 with a nut 78 pinned or cottered thereon, which, with a spring and a plain washer 79 and 80, holds the yoke from jumping and chatter, with just enough friction to allow the yoke to be easily swung by the operator's hand on the steering handle. This is the normal position for maneuvering. When a long run is to be made, the position desired for the yoke can be set and locked by means of a beveled washer 81 fixed to the bracket arm by a pin 82, and which engages with a movable beveled washer 83 having an actuating handle 84. A spring 85 carried by the handle 84 bears against the bracket arm 60 and is adapted to frictionally hold said handle against movement or chatter when the handle is unlocked.

In order to quickly shift, adjust, or clamp the power oar in the vertical plane for depth of immersion of the propeller, the trunnion pin 74 has a threaded extension 86 fitted with a nut 87 having a handle 88. A pair of plain washers 89 and a spring washer 90 are mounted on the trunnion pins to allow the nut 87 to be adjusted so that the spring washer will create just enough friction to hold the trunnion pins in the yoke without chatter or jumping during maneuvering. When it is desired to lock the oar for making a long steady run, the nut 87 may be given the required adjustment merely by a slight turn of the handle 88 when the operator can leave the oar to itself. In ordinary use, however, the frictional adjustment is used, (viz:—elements 74, 75, 89 and 90) when the oar can be set to any desired angle for immersion of the propeller, or for raising the propeller entirely out of the water, as for clearing weeds, rocks, etc., and this may be done instantly with the hand on the oar handle just as with an ordinary oar.

By the means above described, any desired combination of movements of the oar in the horizontal and vertical planes can be had at will, within the limits of sweep planned; also the oar can be locked in any compound angle of these planes desired.

In a power oar, it is necessary to have the supporting bracket secured firmly to the structure of the boat (see Fig. 17), and this bracket may be the same for manufacture to fit the same style of boat, but it must vary in design for various styles of boat and methods of using the power oar. The oar itself remains always the same for manufacture and is intended to be removed and cared for always when not actually in use.

The construction of engine and system of ignition is substantially the same as that disclosed in my applications for U. S. Patents, serially numbered 596,157 and 607,114, dated December 7, 1910, and February 17, 1911, respectively. In the construction shown herein, the crank-case and cylinder-case are of one casting (see Figs. 5 and 12)

and the shaft openings in the crank-case are closed with filling bushes 91, carrying the bronze or Babbitt metal bearings 55, and said bushes 91 are securely held in place by taper pins 92, fitting within reamed holes in the crank-casing, thus avoiding the necessity of bolts and flanges.

A sleeve or liner 93 in the casing 1 provides the cylinder for the working piston 94, and the annular chamber 95 for the water jacket. Said liner has one end fitting within an annular flange 96 of the crank-casing, and the other end receiving the head 97 of the casing top 13; and is adapted to take all of the first and direct heat of the explosion, or burning, which enables the cylinder casing to be constructed of very light metal which will not stand said first or direct heat, or wear of the piston, thus greatly reducing the total weight of the motor. The liner 93 has a plurality of openings 97ª communicating with the annular exhaust chamber 95ª formed in the cylinder casing.

The casing top 13 and head 97 are provided with a centrally bored chamber 99, within which operates a trunk piston 100 that is formed integrally and continuous with the main piston 94. Said trunk piston communicates, through the main piston 94, with the crank casing chamber and conducts the carbureted fuel from said chamber to the ignition chamber 101 formed in head 97, said fuel issuing into said chamber through ports 102 in the upper end of the trunk piston 100. The ignition chamber 101 is surrounded by a bushing 103 forming an annular chamber 104 which has ports 105 that extend from its top to a point near its bottom. A second bushing 100ª within which the trunk piston works is mounted in the chamber 99, and is secured by the bushing 103 which is in turn secured by a screw 103ª in the head 97.

An igniting piston 106 carried by the trunk piston 100 is adapted to work within the ignition chamber 101 and compress, in said chamber to the point of ignition, an isolated portion of the explosive charge taken from the main or explosion chamber. At the instant of such ignition, the annular channel 107 on the piston 106 comes into register with the lower ends of ports 105 and brings said ports into communication with the main explosion chamber when the flame incident to the ignition is liberated into said main explosion chamber and ignites the main charge which is then under compression by the main piston.

The flow of explosive mixture from the crank casing into the main explosion chamber is adapted to be throttled by a valve or plug 108, carried by a rod 109, that has a screw portion 110 adjustably mounted in the threaded portion of a projection 111 on a cover 112, that screws onto an extension 113 of the casing top 13. A cap 114 secured to the rod 109 by a pin 115 serves for adjusting the valve 108.

An important quality of this design lies in the fact that when the motor is run up to a speed which would ordinarily cause the motor to "choke" (*i. e.*, slow down and perhaps stop because of the impossibility of getting the scavenging done and enough clean mixture let in, in time to get a good explosion), the present motor will still get perfect mixture for explosion because the mixture enters and sweeps out the firing cylinder first, and this cylinder, together with the top of the main cylinder, always has clean mixture, even when the speed is so great that the lower end of the main cylinder cannot clean itself during the time the exhaust ports are open.

The initial firing of the motor is effected by a hand firing plug 116 (see Fig. 3) that screws into a threaded opening 117 in the casing top 13 (see Fig. 5), and has communication with the main explosion chamber through the port 118. The plug is designed to withdraw and isolate from the explosive chamber a relatively small portion of the compressed charge, compress this portion by loaded impact to effect ignition, and then liberate within the charged chamber the flame incident to the explosion. For a further description of the construction and manner of operation of the firing device, reference may be had to my application for U. S. Patent bearing the Serial No. 607,113 and dated February 7, 1911. An electric spark plug or other electric sparking device can be screwed into the threaded opening 117 if desired.

The fuel supply is contained in a tank 119 (see Figs. 3 and 4), that is capable of being set in different positions for automatically indicating at intervals the amount of fuel on hand. Said tank is pivotally connected to lugs 120 on the cylinder casing 1, and is adjustably secured to and between the guard tubes 12 by a pair of arms 121. The arms 121 are pivotally connected to the tank, at 122, and have engagement with clamps that are slidably mounted on said guard tubes 12. The adjusting clamps consist each of a part 123, that is slidably mounted on the tube 12, and a similar part 124, at right angles thereto, having an opening through which the arm 121 passes; and a thumb screw 125 threaded in the part 124, together with the block 125ª, serves for securing the tank in different adjusted positions. It is contemplated to use only one thumb screw for setting the tank in different adjusted positions, viz:—the screw on the inboard side, but when there is considerable surge on the tank both thumb screws may be used.

A feed pipe 126 connects the fuel tank with the carbureter 127 (see Figs. 1 and 3)

that is mounted on the crank casing and communicates with the chamber thereof through the opening 128.

From the foregoing, it will be seen that when the tank is set to its lowest position (indicated in Fig. 3) and which is the proper position at the beginning of a run, the fuel would feed through the pipe 126 to the carbureter only until the level of the fuel reached approximately the horizontal plane passing through the inlet opening of said pipe, and at this point the motor would commence to "miss" for failure to get an explosive charge. This would indicate to the operator that the fuel tank needed to be adjusted. When the tank, after adjustment to a higher position, has its contents again used down to the level of the feed pipe inlet, the automatic signal is given by the "missing" of the motor, and the operator again adjusts the tank to a higher position. In this way, the operator can always have an approximate measure of the fuel in the tank, and an automatic reminder as this amount decreases. This is not only of great convenience at all times in the use of the oar, but it may easily be of vital importance for safety in finishing a run and getting to a certain point where a fresh supply of fuel is obtainable.

The circulating water system for cooling the motor, thrust and line shaft bearings; and treating the exhaust gases, employs a pump operated by the propeller shaft for feeding the water and utilizes the "cavitation" created by the propeller for accelerating its flow, and further reducing the exhaust back pressure. The pump consists (see Figs. 9 and 11) of spiral threads 129 on the propeller shaft that receive the water deflected by the scoops 130 through the openings 131 in the sheath shaft, and force said water through the annular space 132 between the sheath and propeller shafts. The water scoops 130 are constructed integral with the spider legs 51 of the propeller guard, and the threads 129 of the spiral pump are formed with the collar 36 secured on the propeller shaft.

The water passes from the annular space or channel 132 (see Fig. 5) into the water jacket 133 of the casing section, or exhaust cap, 3, and then enters the water jacket 134 of the casing section 2 which surrounds the exhaust passage 135, and into the space 135ª surrounding the thrust and line shaft bearings. From the chamber 134 the water enters, through the passageways 136, (see Fig. 6) the cylinder water jacket 95 at that part surrounding the cylinder exhaust chamber 95ª. It then passes upwardly through the forward portion of the cylinder water jacket, being deflected by a web 138, through the space 139 in the casing top (see Figs. 5 and 12), and then down the after portion of the cylinder water jacket, and out through the ejector 140. This ejector consists of a small tubular piece having a threaded end 141, that screws into an opening 142 formed in the cylinder casing adjacent the exhaust chamber outlet 143. A series of slots or saw-cuts 144 are formed in that side of the ejector facing said outlet, and are adapted to receive portions or jets of the issuing exhaust gases, which "shoot" through and "sweep" the circulating water out of the ejector, through the exhaust passageway 135. This spraying and mixing of the exhaust products causes the same to be condensed and consequently decreases the back pressure on the engine. The mixed and sprayed circulating water and exhaust products then pass from the exhaust chamber and exhaust cap through the exhaust turbine (see Figs. 5, 9 and 10) thence out through the tubular propeller shaft 8, and are discharged just abaft the propeller.

The exhaust turbine (see Figs. 9 and 10) consists of a plurality of holes or apertures 145 formed in propeller shaft 8, and its outer reinforcing sleeve 25, and said openings are disposed tangentially to the shaft and are flared outwardly. The edges 146 of the openings are sharply beveled and act to draw in the mixture of water and gases when the propeller shaft is revolving "ahead."

It will thus be seen that the circulating water is forced on its passage first by the scoops 130, then by the spiral pump 129, then by the exhaust ejector 140, and finally by the exhaust turbine. At high speeds, there is still another force acting to finally "pull out" the mixture of water and exhaust products from the propeller shaft, and thus still further reduce the back pressure as well as increase the water circulation; viz:—what is known as "cavitation." This consists of a partial vacuum created in the water immediately behind and at the center of the propeller, and this condition increases as the speed increases so that in extreme cases there is an actual "hole" in the water immediately following the screw. This action of "cavitation" is a well known cause of deficiency in screw propellers when turning at high speeds, and it is proposed to utilize this defect in two ways; viz:—to fill the "cavitated" hole full of the exhaust mixture (under whatever pressure remains in it when it reaches the end of the propeller shaft) and thus help the efficiency of the propeller; and secondly to give the exhaust mixture a further outward impulse and still further decrease the back pressure. This method of utilizing the "cavitation" will also materially decrease the noise of the exhaust entering the water and will, in fact, act in the very desirable capacity of a silencer.

In addition to its function of cooling the motor and condensing the exhaust gases, it is to be noted that the circulating water cools the oar from the motor to the propeller, and incidentally it will be seen that in all this length of the oar, there is not a point where the exhaust is exposed, through a metal surface, to burn the hands of the operator.

The lubricating system comprises a force feed lubricator (see Figs. 3 and 15) mounted in the steering handle 11, and consists of a case 147 that fits within the handle and has screw-threaded engagement therewith, as at 148. A screw 149 is journaled in the head 150 of the case 147 between a collar 151 secured on the screw within the case, and a wing nut 152 secured on the outer end of said screw. A piston nut 153 is adjustably mounted on the screw 149, and has a tubular extension 154 on which is movably mounted a plunger or follower 155 having a washer 156, and the end 157 of the tubular extension is enlarged or flared to prevent the plunger 155 from coming off. A spring 158 is interposed between the piston nut 153 and the plunger 155, and normally acts against the plunger to compress the lubricant within the chamber 159 of the case and force the same through the passage 160 in the crank shaft 18. As the grease is used, the spring 158 pushes the plunger 155 aft until said plunger is stopped by the enlarged end 157 of the tubular extension, when no more grease will feed until the screw 149 is turned to adjust the plunger 155 further aft. By a succession of these adjustments of the plunger all of the lubricant contained within the chamber 159 is consumed. The case 147, with the several members contained therein, is adapted to be removed bodily and filled with the lubricant when desired.

The grease passes from the forward end of the crank shaft through the crank shaft and crank passages 160 and 161 (see Fig. 5), lubricating the line shaft bearings 55 through holes 162, and then enters and fills the chamber 163 provided by the forward and inner shaft reinforcing sleeve 23. A cap 164 closes the rear end of the chamber 163; and screw plugs 165 close the ends of the holes forming the passage 161 through the crank.

The propeller line shaft and thrust bearings are lubricated by the grease from the chamber 163, which feeds through the holes 166; and the piston, piston rod, etc., are lubricated from the grease passage 161 in the crank pin. The crank pin has a hole 167 that feeds the crank pin bearing, and also feeds the bearing of the wrist pin 168 through the passage 169 drilled through the length of the piston rod 170, and said wrist pin has a passage 171 that receives the grease from the connecting rod passage 169 through the hole 172, and from said passage 171 the lubricant is fed through the ducts 173 to the wall of the cylinder and the inner surface of the liner 93.

The tube shaft bearing 32 in the exhaust cap 3 is lubricated by the grease contained in a grease cup 174 that is mounted on said cap, as shown in Fig. 3. Said grease feeds from the cup into the annular chamber 175 (see Fig. 5) and thence through ducts 176 to the shaft bearing.

The lubrication of the firing and trunk pistons is accomplished by a grease cup 177 (see Figs. 12 and 13) that screws into a threaded opening 178 in the casing top 13, and from said cup the grease flows through the passage 179 into an annular space 180 surrounding the bushing 100^a, thence through the ducts 181 to the inner surface of the bushing and the outer wall of the trunk piston. A second passage 182 feeds the lubricant from the cup to an annular space 183, and thence through ducts 184 to the inner surface of the firing bush. The two passages 179 and 182 are provided with small plugs 185 having each a fine hole 186 therethrough, adapted to retard the flow of grease or oil.

The lubrication of the after bearing of the propeller shaft is the same as that used on big steamers, viz:—by a lignum-vitæ sleeve (35) to which the water has access. A screw-threaded opening 187 in the cylinder head (see Fig. 5) is adapted to receive a priming cock for lubricating the cylinder.

The engine starting and reversing device consists of a pair of "spinners" for manually turning the fly-wheel in the forward or reverse direction to impart the initial strokes to the piston. The object is to provide a means for spinning the motor several revolutions and which shall be "fool-proof" and automatically release itself from the fly-wheel as soon as the explosion takes place in either direction and whether the actuating member is released or not, and since the construction of both "spinners" is identical only one need be described (see Figs. 14, 15 and 16).

A wheel or cord disk 187^a is mounted to rotate freely on the hub 188 formed by an inward and annular extension of the fly wheel casing, and a cord 189 of fine metal strands is wound in the peripheral groove 190 of said disk and has one end secured thereto. The other end of the cord passes through a hole 190^a in the fly-wheel casing and is provided with a pulling button 191^a (see Fig. 3). A second wheel or spring disk 191 is also journaled on the hub 188, and has an outer segmental flange 192 disposed against the hub of the cord disk 187^a, as clearly shown in Fig. 15. A volute spring 193 is located between the cord-disk and

spring-disk, and is adapted to turn said cord-disk to re-wind the cord 189 after the same has been pulled to rotate the fly-wheel, as will be presently explained. Said spring has its inner end 194 hooked and secured to the stationary bearing 188, and its outer end portion 195 is thinned down for greater flexibility and connects with the fly-wheel engaging and releasing element. Said element consists of a link 196, which swings on a pin 197 that is either riveted to the spring-disk 191, or slides within a radial slot 198 formed therein. A triangular plate 199, providing a trigger, is mounted on a pivot pin 200 carried by the free end of the link 196, and a pair of projections in the form of pins 201 and 202 are rigidly secured to and carried by said trigger plate. The pin 202 works within a radial slot 203 in the cord-disk 187ª and acts to move the trigger point 204 (when the cord-disk is turned) into engagement with the teeth of the ratchet 205 formed on the inner periphery of the fly-wheel 56. The trigger point 204 is normally held out of engagement with said ratchet, and released from engagement therewith in the operation of the device, by the spring flattened end portion 195. Said spring portion engages with the outside of an extension 206 of the radially movable pin 202 and the inside of the pin 201, and has its extreme end 207 secured to the link pivot pin 197.

The operation is as follows:—

The motor is at rest, the fuel supply is on, and compression firing or any other firing being used. The proper cord is sharply pulled out about twelve or eighteen inches by grasping the button between the first and second fingers and giving a straight pull. This will cause two or three revolutions of the fly-wheel which will be sufficient to charge the cylinder and spark, or fire once or twice. The rotation of the cord-disk 187ª will, by its radial slot 203 acting with the trigger pin 202, cause the trigger 199 to swing on its pivot 200 and the trigger point 204 to move, outwardly through the opening 208 in the spring-disk flange 192, and engage with the fly-wheel ratchet 205. Then the fly-wheel, cord-disk, spring-disk and trigger mechanism will revolve as a unit and the spring will be compressed or wound up from the outside. The instant the cord is released the spring reverses the movement of all parts except the fly-wheel, and pulls them back to normal.

The fly-wheel is left free to go on revolving in the direction pulled, and so long as it goes in that direction the teeth cannot catch on or otherwise interfere with the trigger. Should the motor get an impulse in the reverse direction, for any reason, no breaking or harm can result as the trigger point is pressed back, and down since the trigger pin 202 will slide inwardly in the slot 203. The trigger can also be pressed in toward the center bodily due to its being hung on the pivoted link 196.

The exhaust gases from the motor may be used as a signaling device for the craft and to that end a whistle 209 of any suitable type is mounted on the cylinder casing (see Fig. 3) and receives the exhaust gases from the chamber 95.

It is obvious that those skilled in the art may vary the details of construction and arrangement of parts without departing from the spirit of my invention, and therefore I do not wish to be limited to such features except as may be required by the claims.

What I claim is:—

1. The combination with a boat of a motor oar therefor comprising a motor; a propeller shaft connected to the motor; a propeller on said shaft; a universal support for the motor; a steering handle mounted on the motor; and a mount for the motor support adapted for bodily swinging said support inboard or outboard of the boat, substantially as described.

2. The combination with a boat of a motor oar therefor comprising a motor; a propeller shaft connected to the motor and disposed alongside the boat; a propeller on said shaft; and means for mounting the motor on the boat and swinging the same inboard and outboard transversely of the boat, substantially as described.

3. The combination with a boat of a motor oar therefor comprising a motor; a universal support for the motor; a fulcrumed mount for said support on the boat and adapted for swinging the motor inboard and outboard thereof; a propeller shaft connected to the motor; a propeller on said shaft; and a steering handle mounted on the motor, substantially as described.

4. The combination with a boat of a motor oar therefor comprising a motor; a propeller shaft connected to the motor; a propeller on said shaft; a universal support for the motor; an adjustable mount for said support removably secured to the boat; and means for adjusting the elevation of said mount, substantially as described.

5. The combination with a boat of a motor oar therefor comprising a motor; a propeller shaft connected to the motor; a propeller on said shaft; a universal support for the motor; a bracket secured to the boat; an arm swingingly mounted on said bracket, said universal support mounted on the bracket arm; and means for adjusting and holding the bracket arm at different elevations, substantially as described.

6. The combination with a boat of a motor oar therefor comprising a bracket adapted to be secured to the boat; an arm swingingly mounted on said bracket; a device for hold-

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ing said arm in different elevated positions; a yoke swiveled on said arm; a device for securing said yoke in different lateral positions; a motor having horizontal trunnions journaled on said yoke; a device for securing said trunnions at different set positions; a propeller shaft connected to the motor; and a propeller on said shaft, substantially as described.

7. The combination with a boat of a motor oar therefor comprising a bracket adapted to be secured to the boat; an arm swingingly mounted on said bracket and having an apertured arcuate section; a screw-adjustable pin mounted on said bracket and adapted to engage with said arcuate section for holding the arm in different elevated positions; a yoke swiveled on said arm; a jam locking device for securing said swiveled yoke in different positions; a motor having horizontal trunnions journaled on said yoke; a jam locking device for securing said trunnions at different set positions; a propeller shaft connected to said motor; and a propeller on said shaft, substantially as described.

8. The combination with a boat of a motor oar therefor comprising a support mounted on the boat; a yoke swiveled on said support; a motor having horizontal trunnions journaled on said yoke; a spring washer for placing uniform friction on said trunnions; a device for securing said trunnions in different set positions; a propeller shaft connected to the motor; and a propeller on said shaft, substantially as described.

9. The combination with a boat of a motor oar therefor comprising a support mounted on the boat; a yoke swiveled on said support; a spring washer for placing uniform friction on the yoke swivel; a device for securing the yoke swivel in different set positions; a motor having horizontal trunnions journaled on said yoke; a device for securing said trunnions in different set positions; a propeller shaft connected to the motor; and a propeller on said shaft, substantially as described.

10. The combination with a boat of motor oar therefor comprising a bracket secured to the boat; an arm hingedly mounted on said bracket; a spring washer on said hinge mount for placing uniform friction on said bracket arm; a universal support mounted on said bracket arm; a motor mounted on said support; a propeller shaft connected to the motor; and a propeller on said shaft, substantially as described.

11. In a motor oar, the combination with a tubular propeller shaft having a propeller mounted thereon and a sheath shaft exterior to said propeller shaft; of an inner reinforcing sleeve secured in the after end of the propeller shaft; a fixed hub secured to the after end of the sheath shaft and containing the after bearing of the propeller shaft, and an outer reinforcing sleeve fixed to the after end of the propeller shaft and forming the after journal of said propeller shaft, substantially as described.

12. In a motor oar, the combination of a motor having a fly-wheel; a motor casing inclosing the fly-wheel; a propeller shaft connected to the motor; a propeller on said shaft; a propeller sheath shaft secured to the motor casing; a steering handle secured to the fly-wheel casing; and a guard and supporting bar secured to the motor casing, the propeller sheath shaft, and the steering handle, substantially as described.

13. In a motor oar, the combination of a motor having a fly-wheel; a motor casing inclosing the fly-wheel; a propeller shaft connected to the motor; a propeller on said shaft; a propeller sheath shaft secured to the motor casing; a steering handle secured to the fly-wheel casing; and a pair of tubular guard and supporting bars secured to the motor casing, the propeller sheath shaft, and the steering handle, substantially as described.

14. In a motor oar, the combination with a tubular propeller shaft having a propeller mounted thereon, and a sheath shaft exterior to said propeller shaft, of a fixed hub secured to the after end of the sheath shaft and containing the after bearing of the propeller shaft, and an outer reinforcing sleeve fixed to the after end of the propeller shaft and forming the after journal of said propeller shaft, substantially as described.

15. In a motor oar, the combination with a motor; a propeller shaft connected to the motor; a propeller on said shaft; and accessories for said motor and propeller shaft, of guard and supporting bars for said motor and accessories; and a fuel supply tank adjustably mounted on said bars, substantially as described.

16. In a motor oar, the combination with a motor; a propeller shaft connected to the motor; a propeller on said shaft; and accessories for said motor and propeller shaft, of guard and supporting bars for said motor and accessories; and a fuel supply tank swingingly mounted on the motor and adjustably supported by said bars, substantially as described.

17. In a motor oar, the combination of a motor having a fly-wheel; a motor casing inclosing the fly-wheel; a propeller shaft connected to the motor; a propeller on said shaft; a propeller sheath shaft secured to the motor casing; a steering handle secured to the fly-wheel casing, a pair of guard and supporting bars secured to the motor casing, the propeller sheath shaft, and the steering handle; and a fuel supply tank swing-

ingly mounted on the motor casing and adjustably supported by said bars, substantially as described.

18. In a motor oar, the combination of a motor having a fly-wheel; a motor casing inclosing the fly-wheel; a propeller shaft connected to the motor; a propeller on said shaft; a propeller sheath shaft secured to the motor casing; a steering handle secured to the fly-wheel casing; a pair of guard and supporting bars secured to the motor casing, the propeller sheath shaft, and the steering handle; a fuel supply tank swingingly mounted on said motor casing; and a pair of arms mounted on said fuel tank and adjustably supported on said bars, substantially as described.

19. In a motor oar, the combination of an explosive engine having a water jacket; a tubular propeller shaft connected to the engine; a propeller on said shaft; and a sheath shaft for said propeller shaft, said shafts communicating and providing a water circuit with said water jacket, substantially as described.

20. In a motor oar, the combination of an explosive engine having a water jacket; a tubular propeller shaft connected to the engine; a propeller on said shaft; a sheath shaft for said propeller shaft, said shafts communicating and providing a water circuit with said water jacket; and means on said propeller shaft for forcing water through said circuit, substantially as described.

21. In a motor oar, the combination of an explosive engine having a water jacket; a tubular propeller shaft connected to the engine and providing an exhaust outlet for the explosive chamber and the water jacket; a propeller on said shaft; and a sheath shaft for the propeller shaft providing a water inlet for the water jacket, substantially as described.

22. In a motor oar, the combination of an explosive engine having a water jacket; a tubular propeller shaft connected to the engine and providing an exhaust outlet for the explosive chamber and the water jacket; a propeller on said shaft; a sheath shaft for the propeller shaft providing a water inlet for the water jacket; and means on said propeller shaft coöperable with the engine exhaust for effecting water flow through said shafts and the water jacket, substantially as described.

23. In a motor oar, the combination of an explosive engine having a water jacket; a tubular propeller shaft connected to the engine and providing an outlet for the water jacket; a propeller on said shaft; a sheath shaft for the propeller shaft providing an inlet for the water jacket; and means associated with said propeller shaft for pumping water through said water jacket, substantially as described.

24. In a motor oar, the combination of an explosive engine having a water jacket; a tubular propeller shaft connected to the engine and providing an outlet for the water jacket; a propeller on said shaft; a sheath shaft for the propeller shaft providing an inlet for the water jacket; and a scoop on said sheath shaft for feeding water to said water jacket, substantially as described.

25. In a motor oar, the combination of an explosive engine having a water jacket; a tubular propeller shaft connected to the engine and providing an outlet for the water jacket; a propeller on said shaft; a sheath shaft for the propeller shaft providing an inlet for the water jacket; and a scoop and worm and turbine on said shafts for feeding and pumping water through and out of said water jacket, substantially as described.

26. In a motor oar, the combination of an explosive engine having a water jacket; a tubular propeller shaft connected to the engine and providing an outlet for the water jacket; a propeller on said shaft; a sheath shaft for the propeller shaft providing an inlet for the water jacket; and a guard for the propeller mounted on said sheath shaft and constructed to provide a scoop for feeding water to said water jacket, substantially as described.

27. In a motor oar, the combination of an explosive engine having a casing; a supplemental casing secured to the engine casing; said casings providing a water jacket; a sheath shaft mounted on the supplemental casing and providing an inlet for the water jacket; a tubular propeller shaft connected to the engine and journaled in said sheath shaft and the supplemental casing and providing a water outlet for the water jacket; and a propeller on said propeller shaft, substantially as described.

28. In a motor oar, the combination of an explosive engine having a crank shaft and a casing; a supplemental casing secured to the engine casing and providing an exhaust outlet for the cylinder; said engine casing and supplemental casing providing a water jacket communicating with said exhaust outlet; a sheath shaft mounted on the supplemental casing and providing an inlet for the water jacket; a tubular propeller shaft connected to the crank shaft and journaled in said sheath shaft and the supplemental casing, said propeller shaft communicating with the exhaust outlet of the supplemental casing and providing an outlet for the exhaust gases and the water jacket; and a propeller mounted on said propeller shaft, substantially as described.

29. In a motor oar, the combination of a motor having a casing and a shaft; a tubu-

lar propeller shaft; a propeller on the propeller shaft; an inner reinforcing sleeve on the tubular propeller shaft; a slip joint and a flexible connection between said sleeve and the motor shaft; and an outer reinforcing sleeve on the propeller shaft journaled in the motor casing, substantially as described.

30. In a motor oar, the combination of a motor having a casing and a shaft with a reduced portion provided with key-ways; a tubular propeller shaft journaled in the casing; a propeller on the propeller shaft; an inner reinforcing sleeve on the tubular propeller shaft provided with key-ways; and keys, having inclined side edges, fitting within said key-ways and providing a slip joint and a flexible connection between said shafts, substantially as described.

31. In a motor oar, the combination of a motor having a casing and a shaft provided with key-ways; a tubular propeller shaft; a propeller on the propeller shaft; an inner reinforcing sleeve on the propeller shaft provided with key-ways; keys, having inclined end portions, fitting within said key-ways and providing a slip joint and flexible connection between said shafts; and an outer reinforcing sleeve on the propeller shaft journaled in the motor casing, substantially as described.

32. In a motor oar, the combination of a motor having a casing and a shaft; thrust bearings mounted in the casing; a tubular propeller shaft journaled in said thrust bearings; a propeller on the propeller shaft; an inner reinforcing sleeve on the propeller shaft at said thrust bearing; and a slip joint and flexible connection between the motor and propeller shafts, substantially as described.

33. In a motor oar, the combination of a motor having a casing and a shaft; a tubular propeller shaft; a propeller on the propeller shaft; thrust bearings in said casing; an outer reinforcing sleeve on the propeller shaft and journaled in the thrust bearings; an inner reinforcing sleeve on the propeller shaft; and a slip joint and flexible connection between the motor and propeller shafts, substantially as described.

34. In a motor oar, the combination with a motor; a sheath shaft; and a propeller shaft in the sheath shaft connected to be driven by the motor, of a collar, and a reinforcing sleeve with a propeller secured on said propeller shaft; and a sleeve bearing disposed between the sheath and propeller shafts, and secured to the latter by said collar and hub, substantially as described.

35. In a motor oar, the combination with a motor; a sheath shaft; and a propeller shaft in the sheath shaft connected to be driven by the motor, of a collar riveted on the propeller shaft; a reinforcing sleeve with a propeller mounted on the propeller shaft; and a sleeve bearing disposed between the sheath and propeller shafts; and secured to the propeller shaft by said collar and reinforcement, and said collar adapted to be moved axially on the propeller shaft to remove and renew said sleeve bearing, substantially as described.

36. In a motor oar, the combination with a motor; and a tubular propeller shaft connected to be driven by the motor, of an inner reinforcing sleeve for the shaft; an outer reinforcing sleeve secured on the shaft; a propeller keyed on said outer reinforcement; and a jam nut on the outer reinforcement securing said propeller in keyed position, substantially as described.

37. In a motor oar, the combination with a motor; and a tubular propeller shaft connected to be driven by the motor, of an inner reinforcing sleeve for the shaft; an outer reinforcing sleeve brazed or welded on the shaft; a propeller keyed on said outer reinforcement; and jam nuts screwed on said outer reinforcement and securing the propeller in keyed position, substantially as described.

38. In a motor oar, the combination with a motor; a tubular propeller shaft; and a tubular sheath shaft for the propeller shaft, of an inner reinforcing sleeve for the propeller shaft; a collar and an outer reinforcement secured on the propeller shaft; a bearing sleeve secured on the propeller shaft by said collar and outer reinforcement; a propeller keyed on the outer reinforcement; and jam nuts screwed on the outer reinforcement and securing the propeller in keyed position, substantially as described.

39. In a motor oar, the combination with a motor; a tubular propeller shaft; and a tubular sheath shaft for the propeller shaft, of an inner reinforcing sleeve for the propeller shaft; a collar riveted on the propeller shaft; an outer reinforcement welded or brazed on the propeller shaft, said collar and outer reinforcement having adjacent beveled edges; a lignum-vitæ bearing sleeve secured on the propeller shaft between the beveled edges of said collar and outer reinforcement; and a propeller mounted on the propeller shaft, substantially as described.

40. In a motor oar, the combination with a motor having a crank shaft and a casing; line and thrust bearings in said casing; a propeller shaft journaled in said bearings and connected to said crank shaft; a propeller; and a steering handle mounted on the casing; of lubricating means comprising a force feed lubricator located in said handle and communicating by passageways with the motor and the shaft bearings, substantially as described.

41. In a motor oar the combination with a motor having a crank shaft and a casing; line and thrust bearings in said casing; a

propeller shaft journaled in said bearings and connected to said crank shaft; a propeller; and a steering handle mounted on the casing; of lubricating means comprising a force feed lubricator located in the steering handle and communicating by passageways with the motor; and a lubricant holding chamber located in the end of the propeller shaft and adapted to be supplied from said passageways, and lubricant passages from said chamber to the propeller shaft, line and thrust bearings, substantially as described.

42. In a power oar, the combination of a crank-case and cylinder-case constructed in one casting; a section providing an exhaust chamber; a section providing an exhaust cap; bolts detachably securing said sections with the cylinder and crank casing; a piston; a crank-shaft connected to the piston, a propeller shaft connected to said crank shaft; and a propeller mounted on said propeller shaft; substantially as described.

43. In a motor oar, the combination of an explosive engine having a water jacket, a tubular propeller shaft connected to the engine, a propeller on said shaft, and means associated with the propeller shaft to admit the waste water and exhaust gases for discharge abaft the propeller, substantially as described.

44. In a motor oar, the combination of an explosive engine having a water jacket, a tubular propeller shaft connected to the engine, a propeller on said shaft, and a casing providing a chamber adapted to receive the waste water and exhaust gases from the engine, said propeller shaft having apertures in the sides thereof adapted to admit the waste water and exhaust gases from said chamber for discharge abaft the propeller to prevent cavitation thereat, substantially as described.

45. In a motor oar, the combination of an explosive engine having a water jacket, a tubular propeller shaft connected to the engine, a propeller on said shaft, and a casing providing a chamber adapted to receive the waste water and exhaust gases from the engine, said propeller shaft having apertures in the sides thereof and formed with beveled edges providing an intake turbine to receive the waste water and exhaust gases from said chamber for discharge abaft the propeller to prevent cavitation thereat, substantially as described.

46. In a motor oar, the combination of an explosive engine, a tubular propeller shaft connected to the engine, a propeller on said shaft, and a casing providing a chamber adapted to receive the exhaust gases from the engine, said propeller shaft having apertures in the sides thereof adapted to admit the exhaust gases from said chamber for discharge abaft the propeller to prevent cavitation thereat, substantially as described.

47. In a motor oar, the combination of an explosive engine, a tubular propeller shaft connected to the engine, a propeller on said shaft, and a casing providing a chamber adapted to receive the exhaust gases from the engine, said propeller shaft having apertures in the sides thereof and formed with beveled edges providing an intake turbine to receive the exhaust gases from said chamber for discharge abaft the propeller to prevent cavitation, thereat, substantially as described.

48. The combination with a boat of a motor oar therefor comprising a support mounted on the boat; a yoke swiveled on said support; a motor having horizontal trunnions journaled on said yoke; a spring for placing uniform friction on said trunnions and for absorbing the vibration of the engine; a device for securing said trunnions in different set positions; a propeller shaft connected to the motor; and a propeller on said shaft, substantially as described.

49. The combination with a boat of a motor oar therefor comprising a support mounted on the boat; a yoke swiveled on said support; a spring for placing uniform friction on the yoke swivel and for absorbing the vibration of the engine; a device for securing the yoke swivel in different set positions; a motor having horizontal trunnions journaled on said yoke; a device for securing said trunnions in different set positions; a propeller shaft connected to the motor; and a propeller on said shaft, substantially as described.

50. The combination with a boat of a motor oar therefor comprising a bracket secured to the boat; an arm hingedly mounted on said bracket; a spring on said hinged mount for placing uniform friction on said bracket arm and for absorbing the vibration of the engine; a universal support mounted on said bracket arm; a motor mounted on said support; a propeller shaft connected to the motor; and a propeller on said shaft; substantially as described.

In testimony whereof, I affix my signature, in presence of two witnesses.

WILLIAM BARNUM COWLES.

Witnesses:
P. R. Long,
Frances B. Long.

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J. C. BUTLER.

WATER CIRCULATING AND COOLING PUMP.

APPLICATION FILED JAN. 29, 1917.

1,274,678. Patented Aug. 6, 1918

2 SHEETS—SHEET 1.

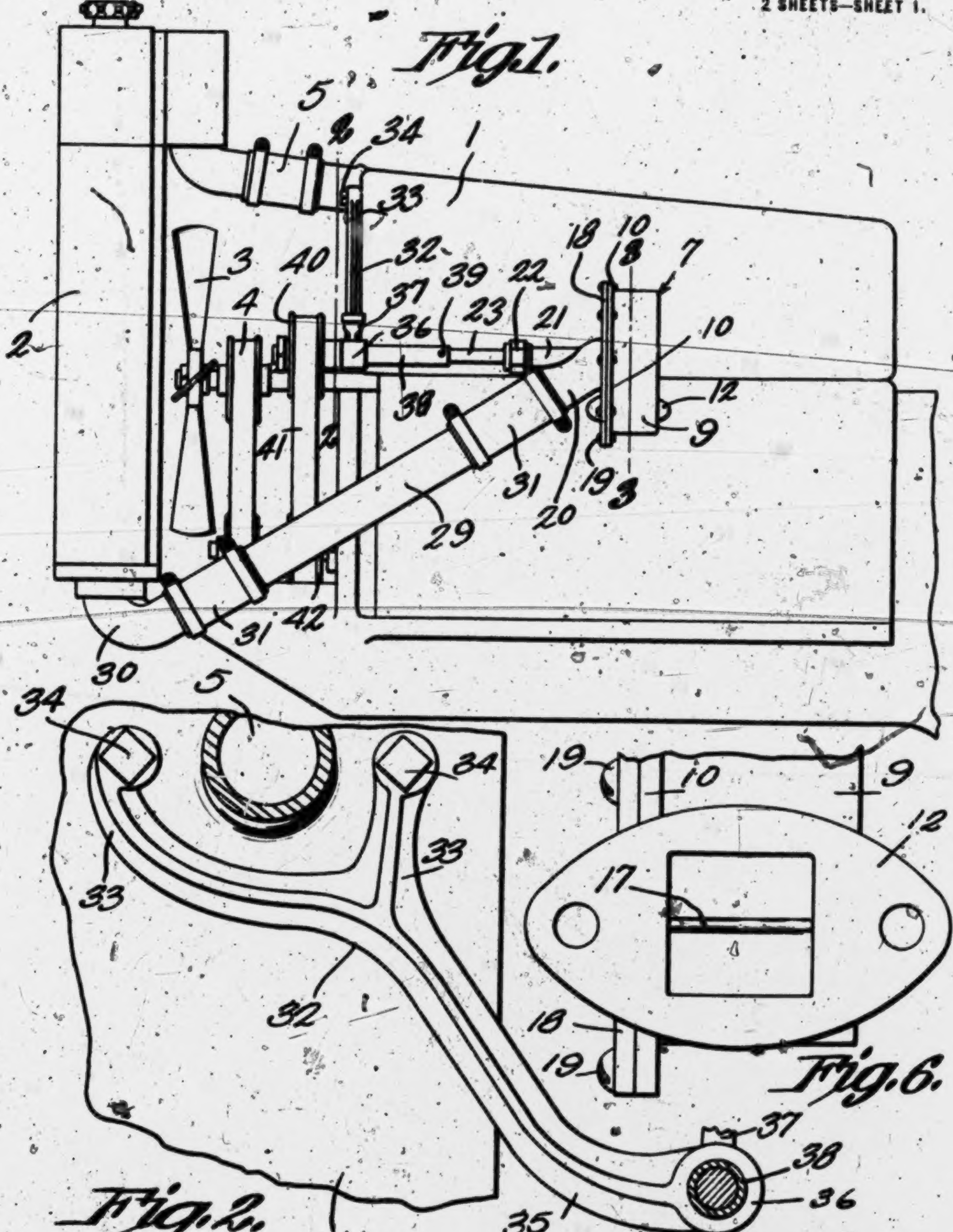

Fig.1.

Fig.2.

Fig.6.

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Joseph C. Butler,

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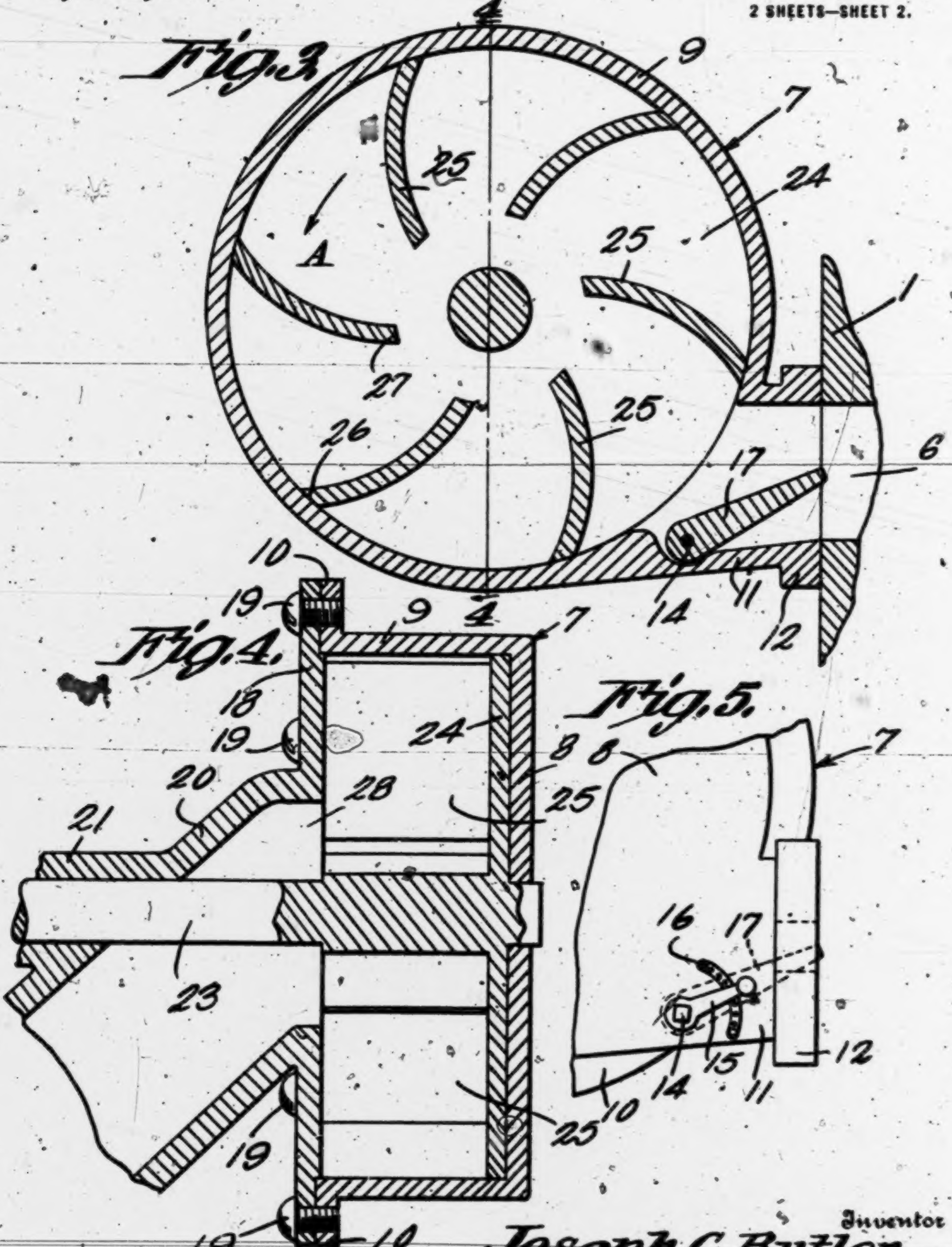
J. C. BUTLER.
WATER CIRCULATING AND COOLING PUMP.
APPLICATION FILED JAN. 29, 1917.

1,274,678. Patented Aug. 6, 1918.
2 SHEETS—SHEET 2.



Witness
R. L. Parker

Inventor
Joseph C. Butler,

By C. A. Snow & Co.
Attorney

UNITED STATES PATENT OFFICE.

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WATER CIRCULATING AND COOLING PUMP.

1,274,678. Specification of Letters Patent. Patented Aug. 6, 1918.

Application filed January 29, 1917. Serial No. 145,237.

To all whom it may concern:

Be it known that I, JOSEPH C. BUTLER, a citizen of the United States, residing at Pomona, in the county of Los Angeles and State of California, have invented a new and useful Water Circulating and Cooling Pump, of which the following is a specification.

The device forming the subject matter of this application is adapted to constitute a part of the circulating system whereby water from the radiator of an internal combustion is conveyed to the cylinders of the engine.

The invention aims to provide novel means for promoting the circulation between the radiator and the cylinders of the engine, to improve the construction of the pump whereby such a circulation is secured, to provide novel means for driving the pump, to provide novel means for regulating the amount of water delivered by the pump into the cylinders and, generally, to improve and to enhance the utility of devices of that type to which the present invention appertains.

With the above and other objects in view which will appear as the description proceeds, the invention resides in the combination and arrangement of parts and in the details of construction hereinafter described and claimed, it being understood that changes in the precise embodiment of the invention herein disclosed can be made within the scope of what is claimed without departing from the spirit of the invention.

In the accompanying drawings:—

Figure 1 shows in side elevation, a portion of an internal combustion engine whereunto the device forming the subject matter of this application has been applied;

Fig. 2 is a section taken approximately on the line 2—2 of Fig. 1, and showing, upon an enlarged scale, the means whereby the pump shaft is supported for rotation;

Fig. 3 is a section taken through the pump;

Fig. 4 is a section taken approximately on the line 4—4 of Fig. 3;

Fig. 5 is a fragmental elevation of the pump, showing the means whereby the gate is controlled; and

Fig. 6 is an end elevation of the structure shown in Fig. 5.

In the drawings there is shown an engine of the kind used on motor propelled vehicles, the cylinders of the engine appearing at 1, and the numeral 2 indicating the radiator. The fan is shown at 3 and is driven in any suitable way, as indicated at 4, from the shaft of the engine. The return pipe between the engine cylinders 1 and the radiator 2 is marked by the reference numeral 5. The numeral 6 in Fig. 3 shows a port whereby water enters the engine cylinders 1.

The pump whereby a circulation between the radiator 2 and the engine cylinders 1 is secured, includes a cup-shaped member 7, comprising a back plate 8 and an annular wall 9 formed integrally with the back plate and provided with an outstanding marginal flange 10. The annular wall 9 of the pump casing is provided adjacent its lower portion with an outstanding neck 11, the bore of which preferably is of square outline. The neck 11 carries a foot plate 12 attached to the engine cylinder, the bore of the neck 11 communicating with the port 6, as clearly indicated in Fig. 3 of the drawings. Mounted to rock in the neck 11 is a shaft 14 operated by a lever 15 disposed exteriorly of the neck, and adapted to coöperate with a segment 16 carried by the neck. Attached to the shaft 14 and operating within the bore of the neck 11 is a gate 17. The pump casing includes a face plate 18 held to the flange 10 by means of securing elements 19 and provided with a depending inlet nipple 20 carrying a bearing boss 21 having a gland 22 at its outer end. Journaled in the boss 21 and in the back plate 8 of the pump casing is a shaft 23 which passes through the gland 22, the obvious function of the gland being to prevent a leakage about the shaft. Formed integrally with the shaft 23 and located within the cup-shaped member 7 of the pump casing is a disk 24 of approximately the same diameter as the back plate 8. Formed integrally with the disk 24 are radial, convexed blades 25, the outer edges of which move, as shown at 26, in close relation to the inner surface of the annular wall 9 of the cup-shaped member of the pump casing. As shown at 27, the inner ends of the blades 25 terminate at the circumference of an opening 28 in the face plate 18, the openings 28 representing the inner end of the bore of the inlet nipple 20. A tube 29 extends between the inlet nipple 20 of the pump casing and the outlet 30 of the radiator 2, suitable clamping

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means 31, of any desired kind, being employed for holding the ends of the tube 29 on the parts 20 and 30.

Mounted on the forward end of the engine is a bracket 32 including upstanding arms 33 attached by securing elements 34 to the engine. The bracket 32 includes a downwardly extended arm 35, terminating in a bearing 36 carrying an oil cup 37. Journaled for rotation in the bearing 36 is a tubular shaft 38 in which the forward end of the shaft 23 is telescoped, the construction being such that the driving connection represented by the shafts 38 and 23 may be lengthened or shortened at the will of an operator, to permit the pump casing to be located in any desired position. The shafts 38 and 23 are held together for simultaneous rotation and against lengthwise movement, by means of a set screw 39, threaded into the shaft 38 and engaging the shaft 23. Secured to the forward end of the tubular shaft 38 is a pulley 40 about which is trained a belt 41 engaging a pulley 42 on the shaft of the engine.

It will be obvious that when the shaft of the engine is rotated, rotation will be imparted to the shafts 38 and 23 by means of the pulley 40 and the belt 41, the bracket 32 serving to space the shafts 38 and 23 from the side of the engine, so that the pump casing may be connected with the engine as shown in Fig. 3.

When the shaft 38—23 is rotated in the manner aforesaid, the blades 25 move, in the direction of the arrow A in Fig. 3, within the contour of the wall 9 of the pump casing. Water is pumped into the pump casing through the inlet nipple 20 and is carried around by the blades 25 and forced out through the bore of the neck 11 and through the port 6 into the water jackets of the cylinders of the engine.

The shaft 14 may be rotated by means of the lever 15 or its mechanical equivalent, and may be held in adjusted positions, thereby to adjust the position of the gate 17, and to regulate the amount of water delivered by the pump into the water jackets of the engine cylinders.

The pump as shown in Figs. 3 and 4 of the drawings is of simple and compact construction, and will be found well adapted for the ends in view. The pump, further, is so constructed that it will withstand the severe usage to which structures of this kind are subjected when they form a part of the water circulating system of an automobile engine.

Having thus described the invention, what is claimed is:—

An internal combustion engine including a shaft, and a cylinder having a water jacket port; a pump casing having a short straight neck secured directly to the cylinder and discharging into the port, the casing being provided on its forward side with an inlet; a rotary member mounted in the casing and having blades operating in a plane at right angles to the engine shaft and parallel to the axis of the neck, the rotary member being located opposite to the port whereby the rotary member will force the water directly in a lateral direction tangentially through the neck and in a straight line into the port; a second shaft constituting a part of the rotary member and journaled in the casing, the second shaft being disposed parallel to the engine shaft; means for connecting the second shaft with the engine shaft; a radiator; a connection between the cylinder jacket and the radiator; and a conduit leading from the inlet to the radiator.

In testimony that I claim the foregoing as my own, I have hereto affixed my signature in the presence of two witnesses.

JOSEPH C. BUTLER.

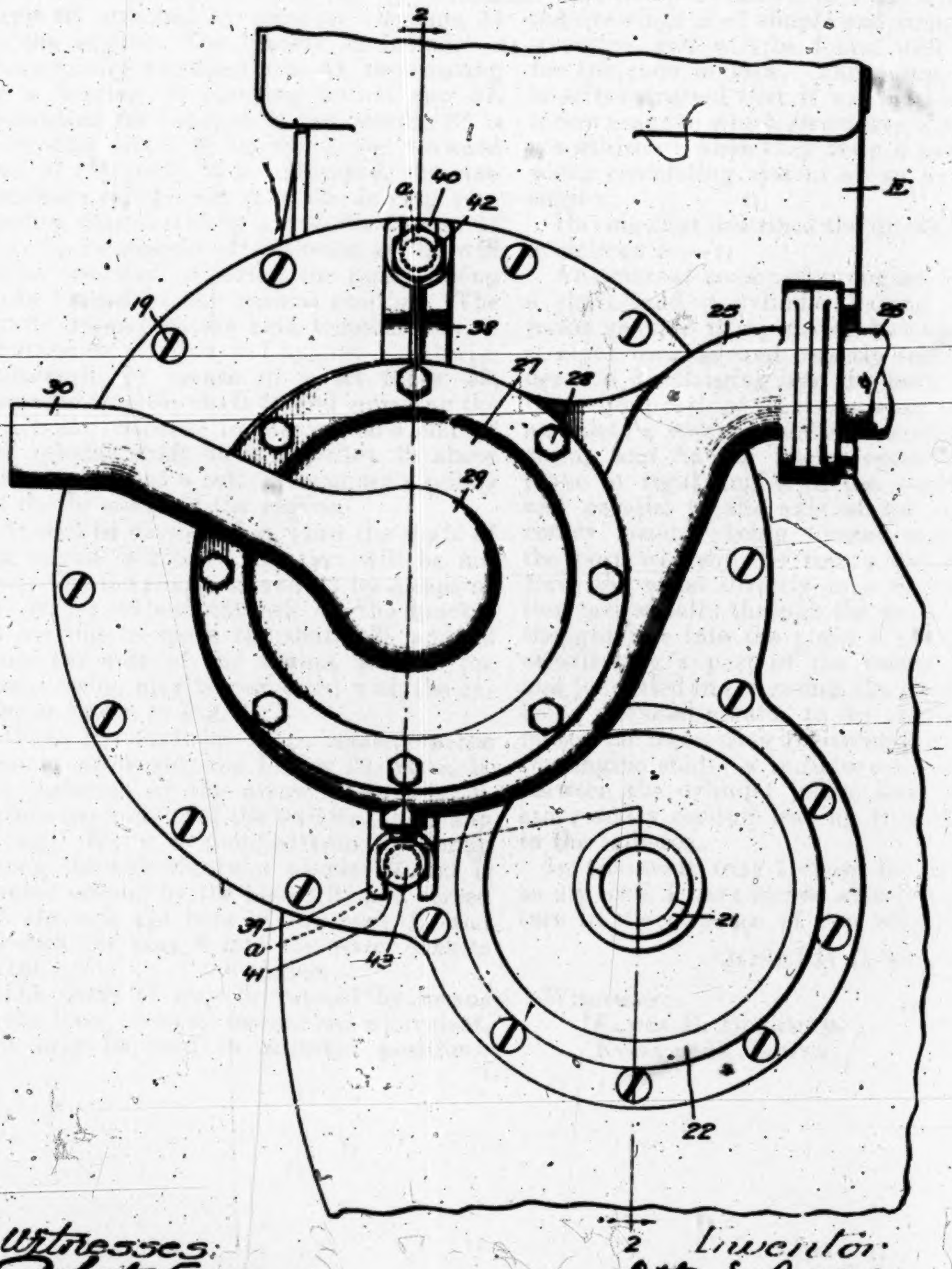
Witnesses:
JAMES E. BURNHAM,
EVERETT H. BOWEN.

454
1,295,234.

O. E. SZEKELY.
WATER PUMP.
APPLICATION FILED MAY 3, 1918.

Patented Feb. 25, 1919
3 SHEETS—SHEET 1.

Fig. 1



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456

1,295,234.

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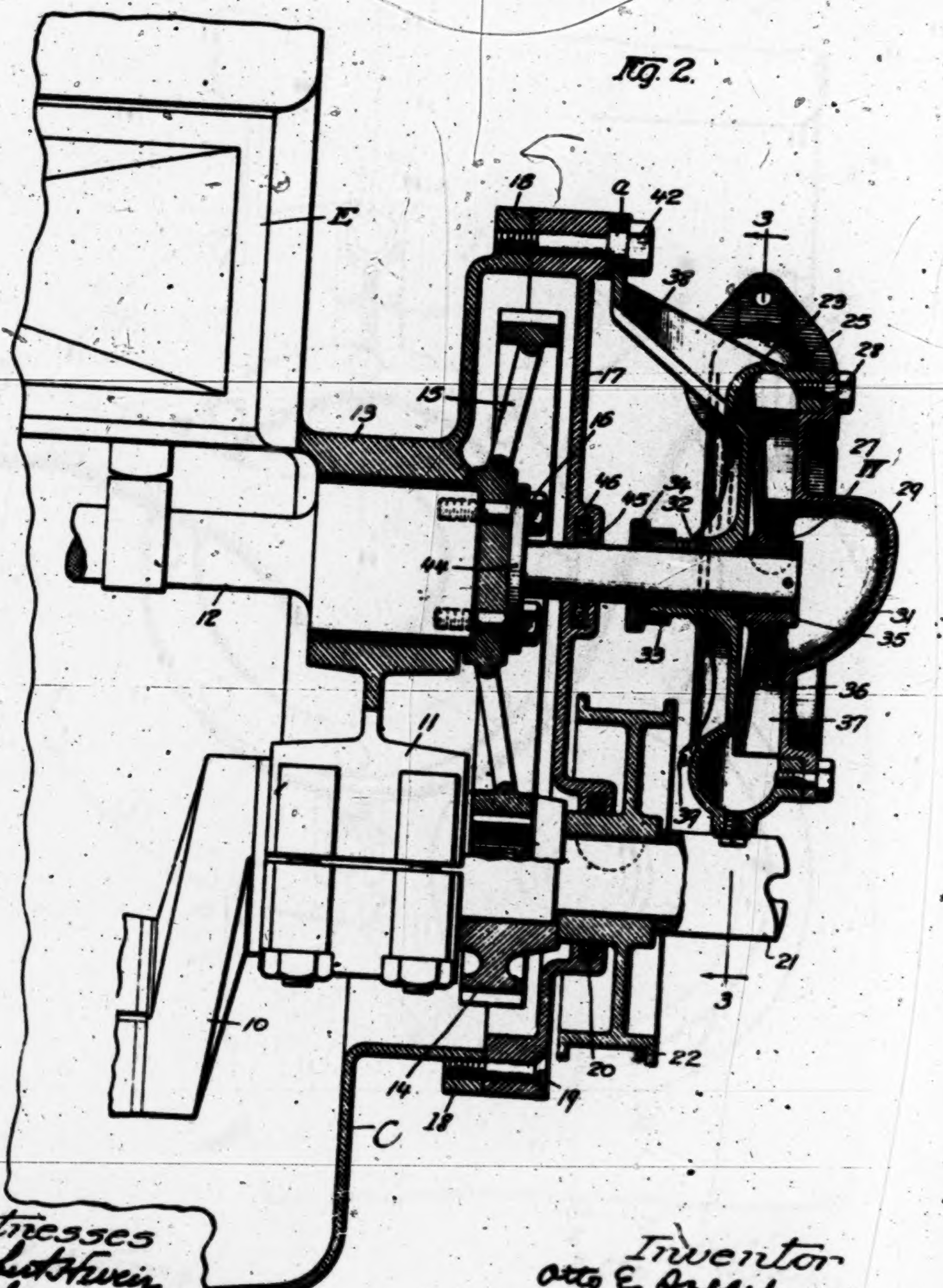
WATER PUMP.

APPLICATION FILED MAY 3, 1918.

Patented Feb. 25, 1919.

3 SHEETS—SHEET 2.

Fig. 2.



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WATER PUMP.
APPLICATION FILED MAY 3, 1918.

1,295,234.

Patented Feb. 25, 1919.
3 SHEETS—SHEET 2

Fig. 3

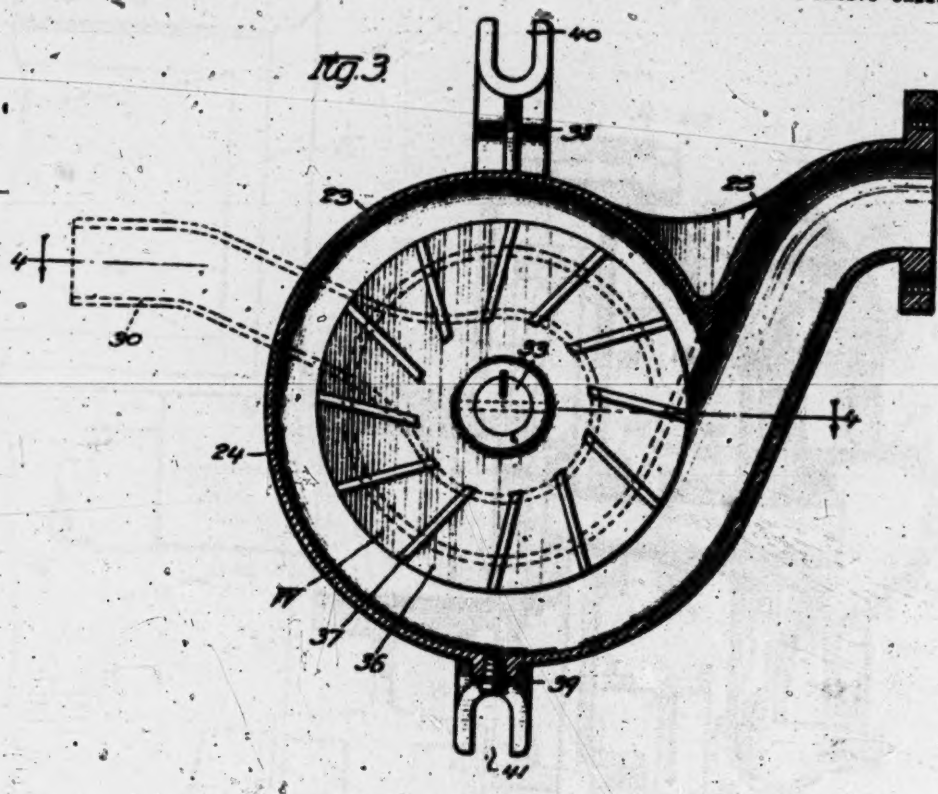
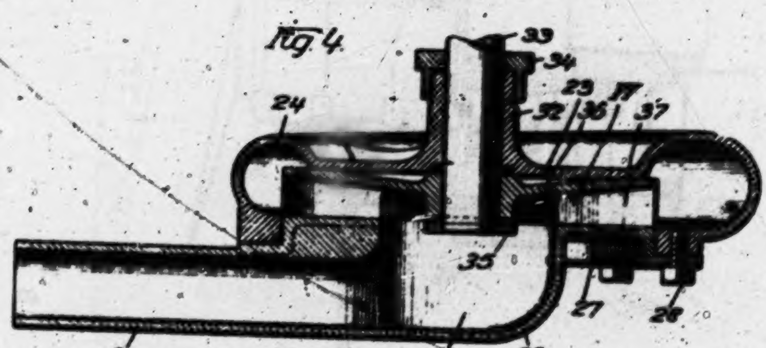


Fig. 4



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UNITED STATES PATENT OFFICE.

OTTO E. SZEKELY, OF ROCK ISLAND, ILLINOIS, ASSIGNOR TO VELIE MOTORS CORPORATION, OF MOLINE, ILLINOIS, A CORPORATION OF ILLINOIS.

WATER-PUMP.

1,295,234. Specification of Letters Patent. Patented Feb. 25, 1919.

Application filed May 3, 1918. Serial No. [illegible].

To all whom it may concern:

Be it known that I, OTTO E. SZEKELY, a citizen of the United States, and a resident of Rock Island, in the county of Rock Island and State of Illinois, have invented certain new and useful Improvements in Water-Pumps, of which the following is a specification.

My invention relates to an improved water pump which can be easily and readily attached to automobile engines for the purpose of circulating the engine cooling water.

In prior arrangements pumps have been provided to be connected to be driven at considerable speed, such pumps being small and usually of the cylinder type. In its travel through the radiator tubing and the engine water jacket passageways the cooling water encounters many obstacles and resistance and where the pump is driven at high speed the water pumped thereby will not flow uniformly through the various passageways, but the flow will be more or less impulsive or vibratory. The water will not have a chance to efficiently absorb heat nor will the radiator have a chance to efficiently dissipate heat.

The object of my invention is to provide a larger pump which can be connected with the engine to be driven at slower speed so that the water flow through the circulatory system will be uniform and the water is given a chance to absorb the heat from the engine and to dissipate the heat during flow through the radiator. This uniform circulation of the water will also permit thermo-siphon circulation, that is, the upward flow of heated water and the downward flow of cooler water. Another object of the invention is to produce a simple compact pump structure which can be easily and quickly attached to or removed from the engine structure, provision being made to connect the pump shaft directly with the engine cam shaft.

The above and other features of my invention are embodied in the structure disclosed on the accompanying drawings, in which—

Figure 1 is an end view of part of an engine structure showing my improved pump applied thereto,

Fig. 2 is a sectional view on plane 2—2, Fig. 1,

Fig. 3 is a sectional view on plane 3—3, Fig. 2, and

Fig. 4 is a sectional view on plane 4—4, Fig. 3.

E represents the cylinders and C the crank case of the engine housing. 10 is the crank shaft which is journaled at one end in the bearing frame 11. 12 is the cam shaft parallel with the crank shaft and journaled in the frame 13. Adjacent the bearing frame 11 is the gear pinion 14 which meshes with the gear 15 secured to the end of the cam shaft by means of screws 16 passing through the hub of the gear 15. The cover 17 is secured to the flange 18 of the engine housing by means of screws 19 and closes the end of the crank case and surrounds the gears 14 and 15, the cover having the outlet 20 for the crank shaft end which supports the crank socket 21. Outside of the cover the crank shaft supports the pulley 22 which in practice is connectal by a belt with the pulley which drives the fan. In prior arrangements pumps have been provided having a driving gear adapted to be brought into mesh with the gear 15, these pumps being driven substantially at crank shaft speed.

My improved pump structure is adapted for attachment with the engine frame to be driven directly by the cam shaft. The pump structure comprises a circular pump body 23 having the annular water compartment 24 from which the outlet pipe 25 extends tangentially to be coupled at its end to a pipe 26 which extends to the top of the vehicle radiator. The cover or cap 27 is secured to the pump body by screws 28 and at the center of this cover is the enlargement 29 from which the pipe 30 extends to

be connected with the bottom of the radiator. This enlargement forms the water entrance chamber 31 for the pump. Extending laterally and axially from the pump body 23 is the bearing hub 32 for journaling the pump shaft 33, a stuffing cap 34 being provided. Inside of the pump the shaft supports the pump wheel *w*. This wheel comprises the hub 35 which supports the circular disk 36 from which the vanes or blades 37 extend laterally. The back of the disk 36 bears against the pump body inner wall and the blades bear at their outer edges against the cover 27. The blades are inclined at suitable angle with reference to the wheel radius depending upon the volume of flow desired, water being drawn into the chamber 31 through the pipe 30 and being expelled by the blades into the annular pump chamber 24 and from thence through the pipe 25 to the radiator.

The pump body has arms 38 and 39 extending radially and laterally therefrom, these arms having the slots 40 and 41 at their ends for receiving the bolts 42 and 43 which thread into the engine housing cover 17 or extend entirely through the cover to thread also into the flange 18. The shaft 33 terminates at its outer end in a flange 44 which has openings for receiving the screws 16 in order that the flange may be secured to the cam shaft in common with the gear 15 to support the pump shaft 33 in axial alinement with the cam shaft. To accommodate the the pump shaft, the cover 17 is provided with the bearing hub 45 having the groove 46 therein for receiving packing 46.

When the pump is to be applied, the cover 17 is removed and the pump shaft secured to the cam shaft, and the cover 17 then replaced. The pump frame is then secured by means of the bolts 42 and 43 and the pump wheel applied to the pump shaft and the pump frame cover 27 secured in place. To prevent binding of the shaft 33 sufficient lost motion is provided between the bolts 42 and 43 and the supporting arms 38 and 39 to permit shifting of the pump frame and self centering thereof with reference to the shaft 33 as the pump is operated. As shown, the enlarged shank sections *a* of the screws 42 and 43 are of slightly less diameter than the width of the slots 40 and 41 and the length of the shank sections is a trifle greater than the thickness of the arms 38 and 39. The slots are also of sufficient depth to leave clearance space between their bases and the enlarged shank sections. This arrangement will permit sufficient play of the pump frame after the screws 42 are turned down tight and the pump frame can therefore readily center itself to prevent binding of the pump shaft 33 therein.

The dimensions of the rotary pump are such that when the pump is connected with the cam shaft of an engine it will deliver the proper volume of cooling water and will cause steady and uniform flow of the water through the various passageways of the cooling circulatory system and at a proper velocity to permit the water to efficiently take up heat from the engine and give the radiator a chance to radiate the heat. I have found that my pump will keep the cooling water at a substantially constant temperature irrespective of the speed at which the engine is running, for at any speed of the engine the flow of cooling water will be steady and uniform. In prior arrangements the higher the engine speed the more rapid the water pulsations and the less the cooling efficiency will be.

I do not desire to be limited to the exact construction, arrangement and operation shown and described as it is no doubt possible to make changes and modifications which would still come within the scope of the invention.

I claim as follows:

1. The combination with a gas engine having a crank shaft and a valve controlling cam shaft driven by the crank shaft, and a housing for said shafts, of a pump shaft extending axially from said cam shaft through said housing, a pump frame detachably secured to said housing, a pump wheel for the pump secured to the pump shaft, said pump having an inlet and an outlet adapted for connection with the cooling water circulatory system for the engine.

2. The combination with an engine having a shaft, a housing for the shaft, an extension on said shaft extending axially therefrom through said housing, a pump frame receiving said shaft extension, a pump wheel within the pump frame secured to the shaft extension to rotate therewith, means for supporting said pump frame on the outside of said housing, said supporting means permitting limited movement of said pump frame to center itself with reference to the pump shaft during rotation thereof, and a fluid inlet and outlet for said frame.

3. The combination with a gas engine having a crank shaft and a cam shaft, a gear on said crank shaft and a gear on said cam shaft, said gears intermeshing to transmit rotation from one shaft to the other, a housing inclosing said gears, a rotary pump frame detachably secured to said housing concentric with said cam shaft, a pump shaft detachably secured to said cam shaft gear to be co-axial with said cam shaft to rotate therewith, a pump piston member secured to the pump shaft, and an inlet and an outlet for said pump frame.

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4. The combination with a gas engine having a crank shaft and a cam shaft, a gear on said crank shaft, a gear secured by its hub to the end of said cam shaft, said gears intermeshing, a housing for said gears, an opening in said housing opposite the cam shaft end, of a pump comprising a pump frame detachably secured to said housing, and a pump shaft extending through said housing opening and detachably secured to said cam shaft gear hub concentric with said cam shaft.

In witness whereof I hereunto subscribe my name this 20th day of April, A. D. 1918.

OTTO E. SZEKELY.

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The combination with a gear housing having a crank shaft and a cam shaft, a gear on said crank shaft, a gear secured by its hub to the end of said cam shaft, said gears intermeshing, a housing for said gears, an opening in said housing opposite the cam shaft end of a pump comprising a [illegible] member detachably secured to said housing, and a pump shaft extending from said housing opening and detachably secured to said cam shaft in direct alignment with said cam shaft.

In witness whereof, I hereunto subscribe my name this [illegible] day of April, A.D. 1922.

OTTO [illegible]

464

H. M. PATCH.

MUFFLER.

APPLICATION FILED JUNE 19, 1919.

1,357,079. Patented Oct. 26, 1920.

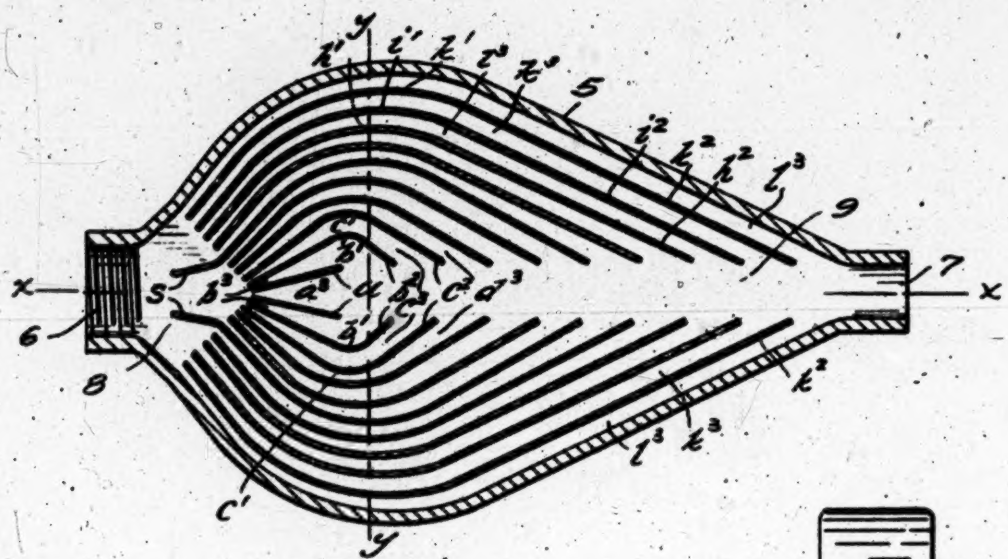


FIG. 1

FIG. 2

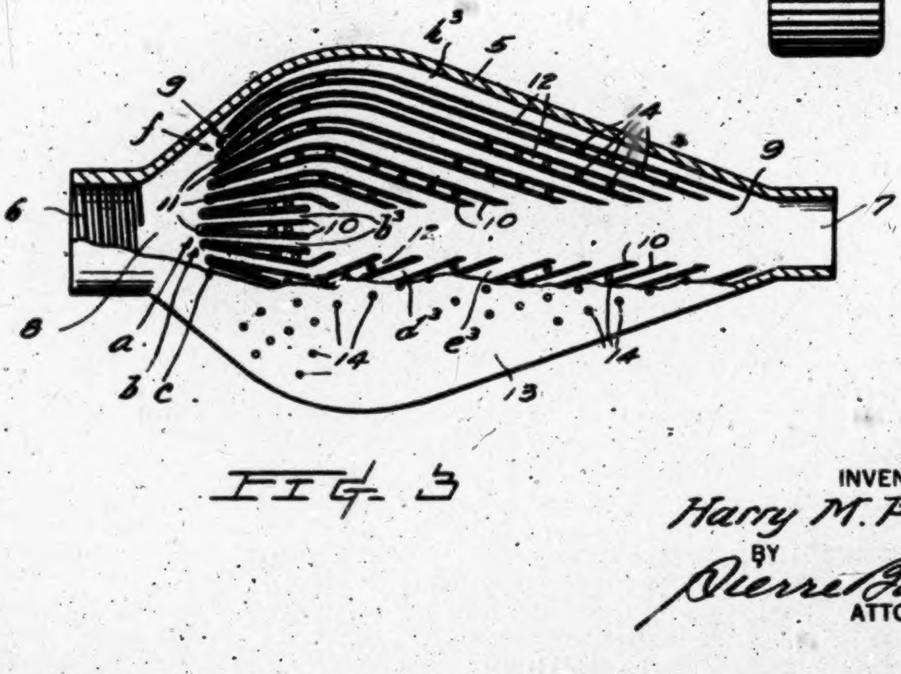


FIG. 3

INVENTOR:

Harry M. Patch

BY

Pierre Barnes

ATTORNEY

UNITED STATES PATENT OFFICE.

HARRY M. PATCH, OF SEATTLE, WASHINGTON.

MUFFLER.

1,357,079. Specification of Letters Patent. Patented Oct. 26, 1920.

Application filed June 19, 1919. Serial No. 305,295.

To all whom it may concern:

Be it known that I, HARRY M. PATCH, a citizen of the United States, residing at Seattle, in the county of King and State of Washington, have invented certain new and useful Improvements in Mufflers, of which the following is a specification.

This invention relates to mufflers for the exhaust gases of internal combustion engines such as are used, more especially, on automobiles and other power driven vehicles.

The object of my invention is the provision of a muffler which will serve to silently discharge the engine exhaust gases and with substantially no back pressure to lessen the efficiency of the engine.

A further object of the invention is to provide a muffler in which is employed a plurality of unobstructed channels through which the gas travels in such a manner as to maintain the interior of the muffler practically free from carbon deposits.

With the above and other objects in view, the invention consists in the novel construction, arrangement and combination of parts as will be hereinafter described and claimed.

In the accompanying drawings, wherein like reference characters designate corresponding parts in all the views, Figure 1 is a horizontal longitudinal section of a muffler embodying my invention in the form now preferred by me. Fig. 2 is an end elevational view of the same. Fig. 3 is a view partly in plan and partly in longitudinal section showing a modified form of the muffler structure.

In said drawings, and referring first to Figs. 1 and 2, the numeral 5 represents a shell or casing which is, by preference, substantially of a pear shape in horizontal section and is provided at one end with an inlet opening 6 which in practice communicates with the exhaust pipe leading from an explosion engine.

At its opposite end, the casing is provided with an outlet opening 7 arranged in axial alinement with the inlet opening and also with the major axis x—x of the casing.

The interior of the casing is provided with a plurality of partitions a, b, c, etc., disposed in similarly arranged groups, as shown in Fig. 1, at opposite sides of the axis x—x to afford a receiving chamber 8 adjacent to said inlet and a central discharge passage 9 extending from said outlet to within a short distance of the receiving chamber. The partitions of each of said groups extend outwardly from the receiving chamber 8 into proximity of the minor axis y—y of the casing near which the inner partitions a, a terminate. The other partitions b, c, etc., continue in curved portions as b^1, c^1, etc., and terminate in inwardly directed straight portions b^2, c^2, etc., which extend to the discharge passage 9, substantially as shown. In order to insure that a proper proportion of the gas will pass through the outer or longer channels, such as k^3 and l^3, one or more of the partitions of such series are advantageously protruded, into the receiving chamber to afford directing elements s. By such configuration and arrangement of the partitions is provided a central flaring channel a^3 connecting the receiving chamber 8 with the discharge passage 9 and a series of curviform channels b^3, c^3, l^3 of progressively greater lengths.

The exhaust from an engine enters the receiving chamber 8 in rapidly recurring impulses and thence encountering the partitions is divided into a series of streams which travel through the various aforesaid channels. These streams, however, are caused to travel different distances, at different speeds and under different degrees of expansion before reaching the discharge passage 9 wherein the streams successively merge in a main stream which is substantially free from impulses and will issue from the muffler in a practically continuous and noiseless discharge.

The modification illustrated in Fig. 3 is substantially similar to the above described embodiment of the invention except with regard to a provision which is made for the admission of air into the muffler and the changes made in the partitions to accommodate the same.

For which purpose each of the partitions is formed of two plate elements 10 joined at the receiving chamber 8, as at 11, and to the rear thereof is spaced to afford a cavity 12 between the respective plate elements and which opens into the passage 9. Provided in the upper and lower walls 13 of the casing (Fig. 3) are perforations 14 opening into the wall cavities 12 for supplying cooling air into the latter whence it escapes in confluence with the branch streams into the main passage 9.

It is to be noted that in the present invention the channels through which the exhaust gases pass contain no baffling devices nor return bends but conduct such gases unobstructedly from the inlet to a discharge passage.

What I claim, is—

1. A muffler comprising a casing having inlet and outlet openings at its opposite ends, series of curviform partitions provided within the casing to divide the same into a receiving chamber at the inlet end and a discharge passage arranged axially of the casing and coextensive with the outlet opening, said partitions also affording channels whereby gas is conducted successively in divergent and confluent streams in traveling from said chamber to said discharge passage.

2. A muffler comprising a casing having inlet and outlet openings at its opposite ends, a plurality of partitions provided in the casing between said openings and affording a central passage and unobstructed channels of different lengths for the flow of gas from said inlet into said passage, said channels communicating through their respective discharge ends with said passage at different distances from said inlet, thereby eliminating the impulses from the exhaust gases and delivering the same in a substantially continuous stream from the muffler outlet.

3. A muffler comprising a casing of substantially a pear shape in transverse section and having an inlet at its oblate end and an outlet at its prolate end, said casing being provided interiorly with series of partitions arranged to afford curviform channels of greater lengths progressively from the major axis of the muffler toward the outer sides of the latter, said partitions being furthermore arranged to afford a receiving chamber adjacent to said inlet and a discharge passage common to all of said channels and communicating with said outlet.

4. A muffler comprising a casing having axially alined inlet and outlet openings at its opposite ends and a discharge passage coextensive with said outlet opening and extending from the latter to within a short distance of the inlet opening, series of partitions arranged in two groups respectively at opposite sides of said passage and affording channels of different lengths in each of said groups between the muffler inlet and said passage whereby the gas is transmitted in a plurality of streams and delivered into said passage at different distances from said inlet to eliminate gas impulses into a substantially continuous stream.

5. A muffler comprising a casing having axially disposed inlet and outlet openings at opposite ends thereof, and a discharge passage coextensive with said outlet opening and extending from the latter to within a short distance of the inlet opening, and a series of partitions dividing the interior of the casing into a plurality of curviform channels whereby the gas is compelled to travel in a plurality of divergent and confluent streams in traveling between said inlet opening and said passage and at different distances in the latter from said inlet opening to eliminate gas impulses into a substantially continuous stream.

6. A muffler comprising a casing having gas inlet and outlet openings at its opposite ends and a plurality of hollow partitions disposed between said openings to provide a central passage which communicates with the outlet opening and a plurality of channels of different lengths making communication between said inlet opening and said passage, said casing being provided in a wall thereof with perforations whereby air is admitted from the external atmosphere into the spaces within the respective hollow partitions.

Signed at Seattle, Washington, this 14th day of June, 1919.

HARRY M. PATCH.

Witnesses:

PIERRE BARNES,

ELIZABETH JOHNSON.

1359-291

468

G. H. TRIPP.

SPARKER CUTTING OUT AND LOCKING DEVICE.

APPLICATION FILED MAY 13, 1920.

1,359,291.

Patented Nov. 16, 1920.

2 SHEETS—SHEET 1.

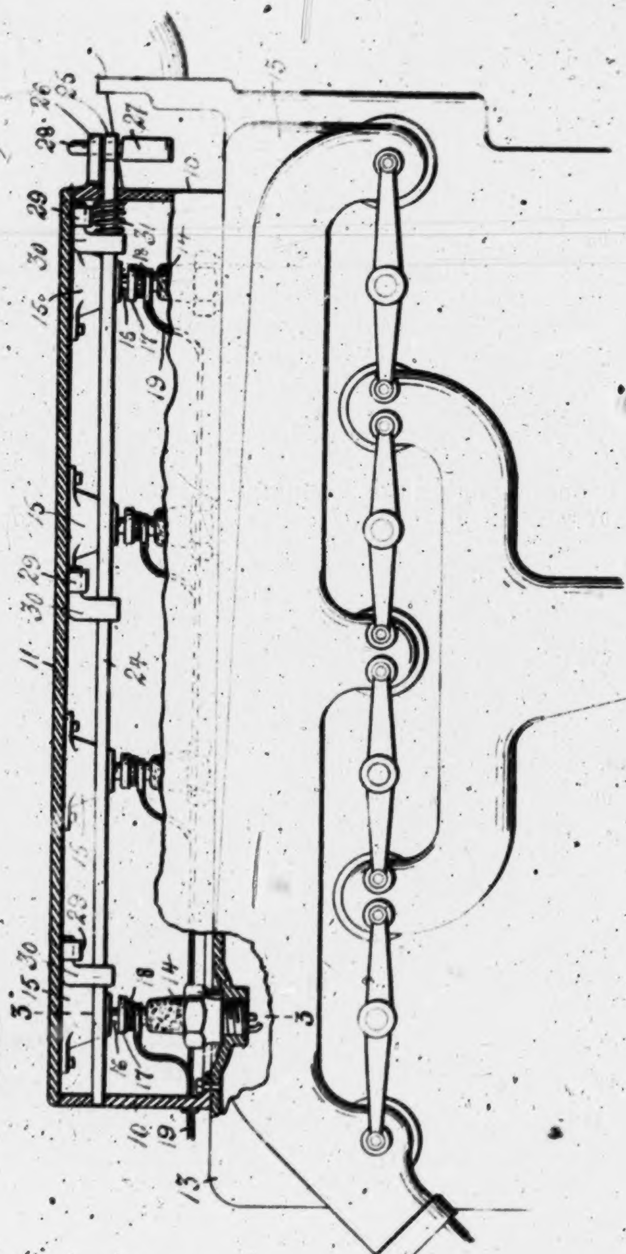


Fig. 1.

Inventor

GUY H. TRIPP,

By Geo. P. Kimmel

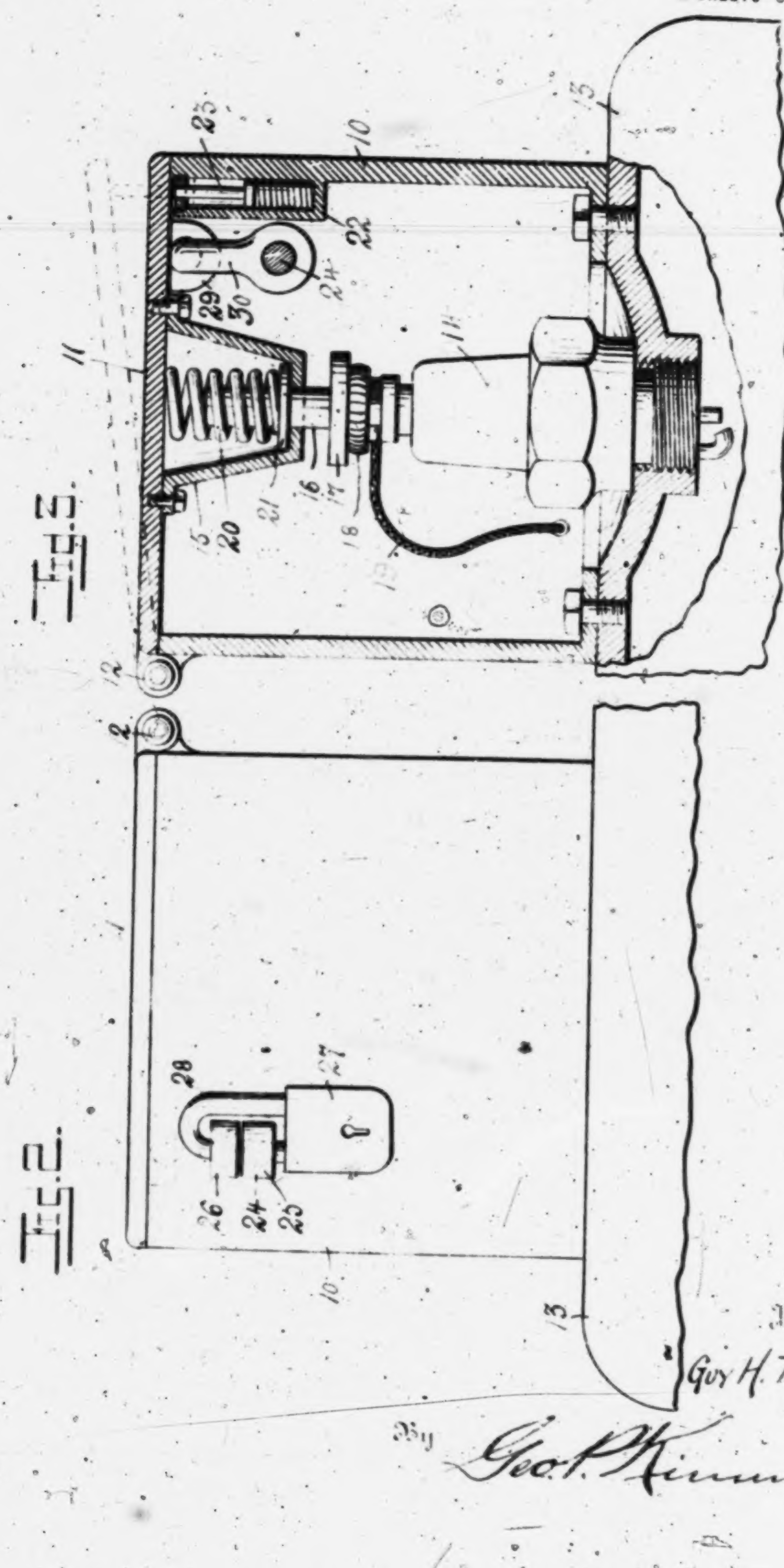
Attorney

470

G. H. TRIPP.
SPARKER CUTTING OUT AND LOCKING DEVICE.
APPLICATION FILED MAY 13, 1920.

1,359,291. Patented Nov. 16, 1920.

2 SHEETS—SHEET 2.



Inventor
Guy H. Tripp,
By Geo. P. Kimmel
Attorney

UNITED STATES PATENT OFFICE.

GUY H. TRIPP, OF MUSKEGON HEIGHTS, MICHIGAN.

SPARKER CUTTING-OUT AND LOCKING DEVICE.

1,359,291. Specification of Letters Patent. Patented Nov. 16, 1920.

Application filed May 13, 1920. Serial No. 381,020.

To all whom it may concern:

Be it known that I, GUY H. TRIPP, a citizen of the United States, residing at Muskegon Heights, in the county of Muskegon and State of Michigan, have invented certain new and useful Improvements in Sparker Cutting-Out and Locking Devices, of which the following is a specification.

This invention relates to attachments to motor driven vehicles for protecting the vehicle from unauthorized use in the absence of the owner, and has for one of its objects to provide a simply constructed device whereby the sparker plugs are short circuited and the short circuiting means locked from access by unauthorized persons.

With these and other objects in view the invention consists in certain novel features of construction as hereinafter shown and described and then specifically pointed out in the claims, and in the drawings illustrative of the preferred embodiment of the invention.

Figure 1 is a side elevation of a portion of an internal combustion engine casing, partly in section, with the improvement applied.

Fig. 2 is an end elevation enlarged, of the parts shown in Fig. 1.

Fig. 3 is a transverse section enlarged on the line 3—3 of Fig. 1.

The improved attachment includes a cover or casing represented as a whole at 10 and having a closure 11 hingedly united thereto at 12. The casing 10 is attached to or formed integral with the upper part of the engine casing, a portion of which is indicated at 13, and covers and incloses the sparker plugs, represented conventionally at 14.

Attached to the under face of the closure 11, are a plurality of bracket devices 15 one for each sparker plug.

Slidable in each bracket is a plunger 16 each having a head 17 adapted to engage the head 18 of the adjacent clamp screw whereby the conductor element 19 is secured to the plug.

Each plunger is spring pressed as shown at 20, and is provided with a washer 21 upon which the spring bears.

The plungers are so proportioned that when the member 11 is in closed position, the several heads 17 of the plungers will contact respectively with the several heads 18 of the sparker plugs and thus short circuit them and prevent them from functioning.

Located at one point on the front wall of the casing 10 is a socket 22 to support a spring pressed plunger 23 operating to hold the closure 11 sufficiently elevated to maintain the plungers 16 and 17 normally free from the clamp screw heads 18 of the sparker plugs as shown by dotted lines in Fig. 3.

Slidably supported in the ends of the casing 10 and extending entirely through the casing is a locking rod 24, the rod having a perforated enlargement 25 at one end externally of the casing, to coact with a perforated lug 26 extending from the casing, to receive a suitable lock, indicated conventionally at 27 the "hasp" 28 of the lock serving as a bolt to hold the part 24—25 in its outward position.

Depending from the under face of the closure 11 at suitable intervals are perforated lugs 29, and attached to the rod 24 at corresponding intervals are catch devices 30 adapted to enter the perforations of the lugs and thus lock the member 11 in closed position when the rod 24 is drawn outwardly and the lock 27 applied.

A spring 31 is disposed between one of the members 30 and the adjacent end of the casing 10, and operates to hold the rod 24 in inoperative position with the pins 30 out of engagement with the lugs 29 and the cover 11 released, so that it can be elevated into the position shown by dotted lines in Fig. 3 by the action of the spring pressed bolt 23.

Any required number of the lugs 29 and pins 30 may be employed, but generally three will be sufficient, as shown.

By this simple arrangement, when the lock 27 is detached the rod 24 will be released and the spring 31 will move it longitudinally of the casing 10 and release the closure 11 when the spring pressed plunger 23 will elevate the closure 11 to a sufficient extent to disconnect the plungers 16 and 17 from the spark plugs 14 leaving the latter free to function properly.

When the owner of the vehicle leaves the same he forces the member 11 into closed position against the resistance of the pin 23 and draws the rod 24 outwardly until the apertures of the parts 25 and 26 register and applies the lock 27—28 thereto.

The outward longitudinal movement of the rod 24 causes the pins 30 to enter the perforations of the lugs 29 and effectually locks the member 11 in closed position.

The closing of the cover 11 causes the heads 17 of the plungers 16 to strongly contact with the heads 18 of the sparker plug set screws and thus short circuit the plugs and render them inoperative and the vehicle safe from surreptitious operation until the lock 27 is removed.

I have thus produced a simple and easily applied means for locking the vehicle from use during the absence of the owner.

The device is simple in construction and can be adapted without material structural change, to motors of various makes.

The preferred embodiment of the invention is disclosed in the drawings and set forth in the specification, but it will be understood that any modifications within the scope of the claims may be made in the construction without departing from the principle of the invention or sacrificing any of its advantages.

I claim—

1. The combination with an internal combustion engine including the sparker plugs thereof, of a casing inclosing said sparker plugs, a movable closure for said casing, contacts corresponding to the sparker plugs carried by said movable closure, means for yieldably holding said movable closure with the contacts thereof separated from the sparker plugs, and means for locking said movable closure to the casing against the resistance of the yieldable holding means to cause the contacts thereof to engage the sparker plugs and short circuit the same.

2. The combination with an internal combustion engine including the sparker plugs thereof, of a casing inclosing said sparker plugs, a movable closure for said casing, contacts corresponding to the sparker plugs carried by said movable closure, a rod slidable through said casing, perforated lugs carried by said closure, pins carried by said rod and adapted to engage in said lugs when the rod is in one position, and means for locking the rod in its outward position.

In testimony whereof, I affix my signature hereto.

GUY H. TRIPP.

474

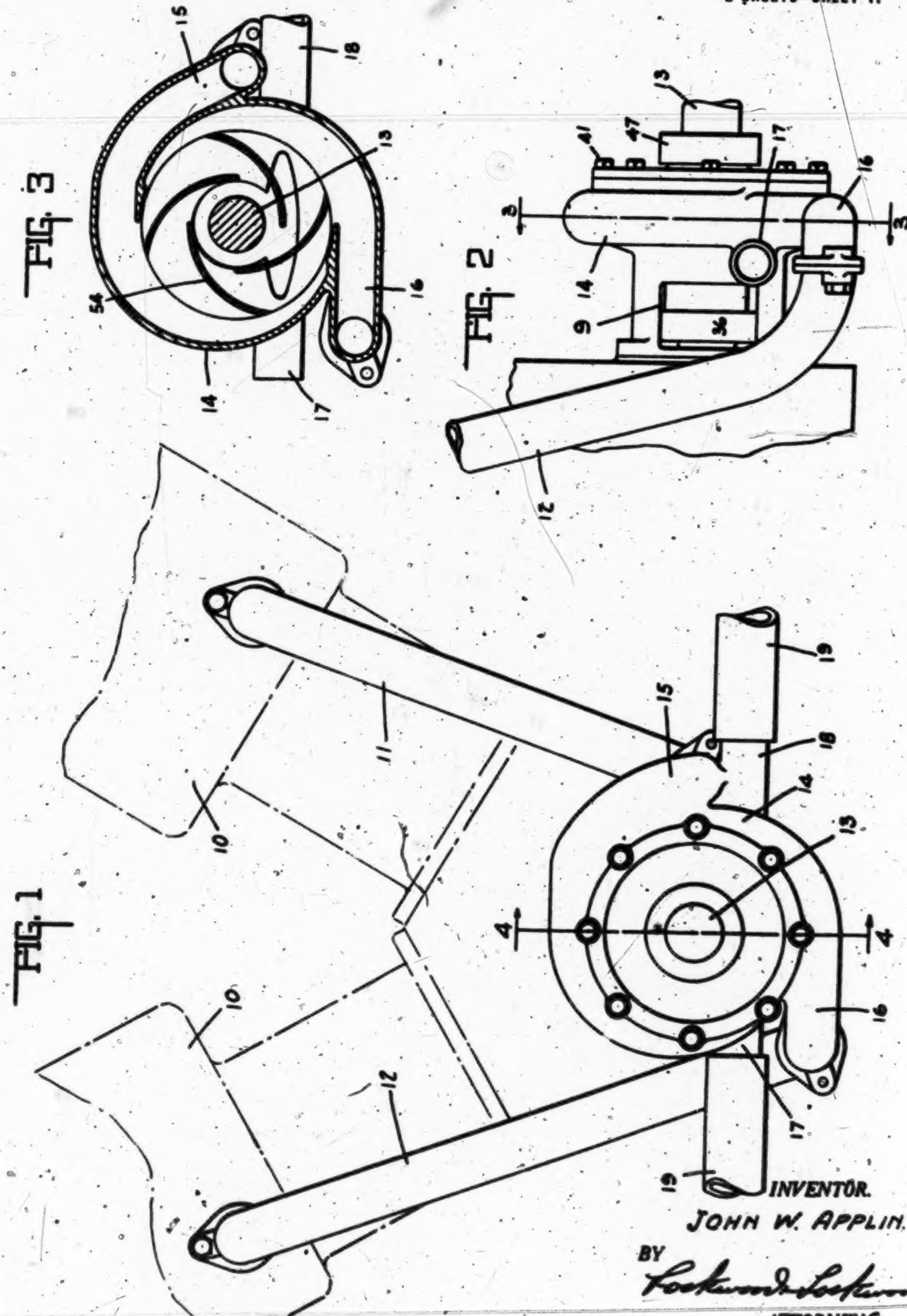
J. W. APPLIN.

WATER PUMP FOR INTERNAL COMBUSTION ENGINES.

APPLICATION FILED JAN. 10, 1920.

1,366,149. Patented Jan. 18, 1921

2 SHEETS—SHEET 1.



INVENTOR.

JOHN W. APPLIN

BY Lockwood & Lockwood

ATTORNEYS.

476

J. W. APPLIN.

WATER PUMP FOR INTERNAL COMBUSTION ENGINES.

APPLICATION FILED JAN. 10, 1920.

1,366,149. Patented Jan. 18, 1921.

2 SHEETS—SHEET 2.

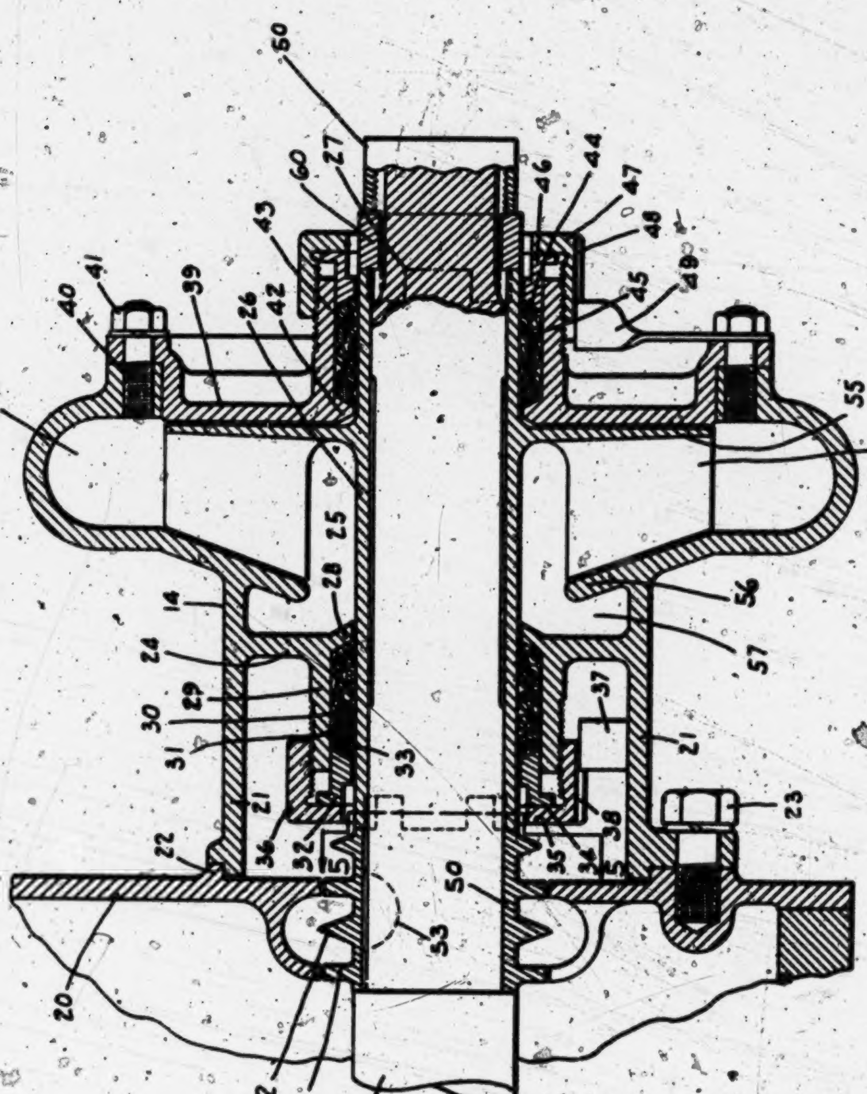


FIG 4

FIG 5

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477

JOHN W. APPLIN, OF INDIANAPOLIS, INDIANA, ASSIGNOR TO LA FAYETTE MOTORS COMPANY, A CORPORATION OF DELAWARE.

WATER-PUMP FOR INTERNAL-COMBUSTION ENGINES.

1,366,149. Specification of Letters Patent. Patented Jan. 18, 1921.

Application filed January 10, 1920. Serial No. 350,515.

To all whom it may concern:

Be it known that I, JOHN W. APPLIN, a citizen of the United States, and a resident of Indianapolis, county of Marion, and State of Indiana, have invented a certain new and useful Water-Pump for Internal-Combustion Engines; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, in which like numerals refer to like parts.

The chief object of this invention is to provide in an internal combustion engine and the like a novel and improved water pump for cooling the same, and mounting said pump upon the crank shaft of the engine.

One feature of the invention is in providing in an engine of the V-block type a pump for cooling each block of cylinders in the engine, and in providing the same with a combined housing and a combined rotor, the rotor being mounted directly upon the crank shaft of the engine.

A further feature of the invention consists in mounting the pump upon the forward end of the crank shaft, and in utilizing the portion of the crank case of the engine as a portion of the housing for the pump.

The full nature of this invention will be understood from the accompanying drawings and the following description and claims.

In the drawings Figure 1 is an end view of an internal combustion engine of the V-block type, and the novel and improved pump mounted upon the crank shaft of the engine and connected with the water jackets of the engine. Fig. 2 is a side view of the pump shown in Fig. 1. Fig. 3 is a sectional view of the interior of the pump chamber and rotor, and is taken on the line 3—3 of Fig. 2 in the direction of the arrows. Fig. 4 is a central sectional view of the pump showing the mounting thereof upon the crank shaft of the engine and taken on the line 4—4 of Fig. 1. Fig. 5 is a cross sectional view of the pump rotor driving means and taken on the line 5—5 of Fig. 4.

In the drawings 10 indicates the water jacket of an internal combustion engine of the V-block type to which this invention has been applied. 11 and 12 indicate respectively water tubes connecting the pump with the water jackets. 13 indicates the crank shaft of the engine connected in the usual manner thereto. Upon the forward end of said crank shaft there is mounted a pump housing 14, the same provided with discharge outlets 15 and 16 respectively communicating with the water tubes 11 and 12. The pump is herein shown provided with a plurality of inlet water tubes 17 and 18, the same supplying water to the respective water tubes 11 and 12 by means of a rotor in the pump casing. Suitable conduit means 19 are connected with the inlet tubes 17 and 18 and connect the same to a suitable radiator not shown.

In Fig. 4 the mounting of said pump upon the crank shaft is shown in detail. Said shaft extends through the crank casing 20, and upon the forward end of the shaft there is positioned the housing 14, the same having an annular groove 21 cut in the edge thereof. The crank case has a complementary formed annular rib 22 coöperating with said groove. The housing 14 is secured to the crank casing in any suitable manner, such as by the bolts 23. In said housing there is positioned approximately midway a transverse partition 24, the same forming one wall of the pump chamber 25. A rotor sleeve 26 is secured upon the crank shaft 13 by a forward and a rearward drive member 27 and 27ª respectively so that said sleeve rotates with said shaft and is supported thereby.

The transverse partition 24 extends inwardly until the same forms a retaining guide wall 28 of the pump chamber. Extending rearwardly of said transverse partition is a cylindrical portion 29, the same being concentric with said sleeve and said shaft and spaced therefrom to form an annular packing chamber 30. The packing 31 is secured in said chamber by means of an annular packing ring 32, the same having a conical face 33 for engaging and compressing said packing within said packing chamber. The packing ring is also provided with a rearwardly and outwardly extending annular flange 34 by which the same is adjustably secured within the packing chamber. A cap 35 engages said annular flange and holds the same within said chamber. Said cap is adjusted in position relative to said chamber to compress said packing by means of the interiorly threaded flange 36,

the same being secured upon the threaded end of the cylindrical projection 29. The means for securing the cap 35 and holding the same against rotation comprises a locking block or tooth 37, the same engaging a slot 38 formed upon the exterior of the adjustable cap. Access to the cap 35 is obtained through openings 9 in the housing.

The pump housing 14 is open at its forward end and by this means the sleeve 26 may be inserted upon the crank shaft and keyed thereto, as described, the housing being closed by a front cover portion 39 secured to the housing in any suitable manner, as by means of the studs 40 and the nuts 41. Said front portion extends inwardly and forms a retaining wall 42 for packing and the like. Extending forwardly along the sleeve and concentric with the shaft is a cylindrical projection 43 threaded upon its exterior and suitably spaced from said sleeve to form a forward packing chamber 44. In said chamber is secured the packing 45, the latter being secured therein by a ring 46 similar to the ring 34. Said ring is secured in said packing chamber by a packing cap 47 similar to the cap 35, said cap being provided with a slot 48 adapted to be engaged by the tooth 49 for securing said cap against rotation and in the adjusted position. The pump chamber 25 is thus formed within said housing and around said sleeve and is concentric with the crank shaft.

Means for securing the sleeve rotor 26 to the shaft 13 comprises a forward and a rearward driving sleeve 27 and 51 respectively. The rearward driving sleeve 51 is provided with a plurality of throw-off rings 52 and is secured to the shaft 13 by suitable means such as the key 53. The sleeve 26 and the driving sleeve 51 have abutting ends which have suitable complementary tongues and grooves formed thereon as shown in Fig. 5. The abutting ends of the forward driving sleeve 26 are similarly provided with suitable tongue and groove connections as shown by the dotted lines in Fig. 4. The sleeve 27 is secured to the shaft 13 by a plurality of keys 60. The sleeves 26, 27 and 51 are secured against longitudinal movement along the crankshaft 13 by a cap 50 having a threaded connection with the shaft.

The means for forcing the water from the inlet tubes out through the discharge openings and to the conduits 11 and 12 comprises the curvilinear fins or blades 54 suitably secured in the pump chamber 25 to a transverse blade supporting 55 of the sleeve 26, herein shown in dish form. Said blades are preferably of greater width near the center than near the outer end thereof, see Fig. 4, the housing being similarly formed and having an inwardly extending annular flange 56 separating the inlet portion 57 of said pump chamber from the rotary portion thereof. Said inlet chamber communicates with the rotary portion through the pump chamber 25. The rotor discharges the water or cooling medium into the discharge chamber 58, said discharge chamber being in the form of a substantially involute curve member imposed upon the rotary portion of the pump chamber.

As shown clearly in Figs. 1 and 3 the inlet 17 supplies water to the inlet portion 57 of the pump chamber 25 and the blades of the rotor carry the same to the discharge chamber 58 from whence it is discharged through the outlet 15. Similarly the cooling fluid is supplied to the pump chamber 25 by means of the inlet tube 18 and is discharged therefrom by means of the discharge outlet 16. It will be noted that the pump is thus duplex, although the same is provided with but one housing or casing and one rotor.

It will also be noted that the crank shaft of the engine is the main driving shaft of this duplex pump, and in this manner power usually lost in friction is eliminated.

The housing as shown is so constructed that after the front cover portion 39 has been removed from the housing and the cap 50 likewise removed from the shaft, the rotor may be removed longitudinally of the shaft. If desired the housing may be removed by the shaft, or the housing and the rotor may be removed from the shaft as a unit after the securing means, such as bolts 23, have been removed. With this construction the parts may be readily removed and the same are few in number and compactly arranged.

While the invention has been described in great detail it will be understood that the broader features thereof are not to be limited by the details of the description, as many modifications thereof will suggest themselves to those skilled in the art.

The invention claimed is:

1. In a fluid cooling pump for an internal combustion engine or the like the combination with the crank shaft and the crank case thereof, said crank shaft projecting through said crank case, of a pump housing secured upon said crank case and extending forwardly thereof, and surrounding the free end of said shaft, said shaft extending through the same, and a pump rotor within said housing and non-rotatably secured upon the housing inclosed portion of said shaft.

2. In an internal combustion engine the combination with the crank shaft and crank case extending through and beyond said case, a housing secured upon the forward face of said crank case and extending forwardly thereof to inclose the crank shaft

extension and having a pump chamber therein, said housing having an opening in the forward face thereof, a rotor within said chamber non-rotatably and slidably mounted upon said crank shaft for rotation therewith, a cover for the open face of said housing, and means for securing said cover to said housing, said pump rotor being slidably removable from said housing and said shaft when the cover is removed.

3. In an internal combustion engine the combination with the crank case and crank shaft extending through and beyond said case, a housing secured to and extending forwardly of said crank case and surrounding said crank shaft, said housing being provided with a pump chamber therein, a rotor non-rotatably and slidably mounted upon said shaft and rotatable by the crank shaft in said pump chamber, and means for securing said housing to said crank case, said means being removable for slidably removing said rotor and the housing from said shaft.

4. In an internal combustion engine the combination with a crank case and a crank shaft thereof, a housing removably secured upon said crank case and extending forwardly thereof, said crank shaft extending forwardly through said housing, said housing having a pump chamber therein and an opening in the forward face thereof, a partition in said housing extending transversely of the shaft and providing a packing chamber, a rotor slidably mounted upon said shaft and rotatable therewith and in said chamber, and a cover for the open face and removably secured to the housing, a packing chamber formed in said cover, said rotor being slidably removable from said pump chamber when the cover is removed and said housing and said rotor being slidably removable upon said crank shaft when the housing is detached from said crank case.

5. In a fluid cooling pump for an internal combustion engine or the like the combination with the crank shaft and the crank case thereof, of a pump housing secured to said casing and extending forwardly thereof, a partition in said housing extending transversely of the shaft and forming a packing chamber for the pump, a rotor rotatable in said housing by the shaft, and adjustable means associated with said partition, said housing having an opening between said partition and said crank case to provide access to said adjustable means.

6. In a fluid cooling pump for an internal combustion engine the combination with the crank shaft, of a pump rotor sleeve slidable longitudinally of said shaft, a plurality of sleeves secured to said shaft adjacent said rotor sleeve and coöperating means upon the adjacent ends of said sleeve for driving said rotor sleeve by said shaft.

7. In a fluid cooling pump for an internal combustion engine the combination with the crank shaft, of a pump rotor sleeve slidable longitudinally of said shaft, tongue and groove means upon the ends of said sleeve, complementarily formed driving means upon the crank shaft adjacent the rearward end of said sleeve, a driving sleeve secured to said shaft and slidable thereon, complementarily formed tongue and groove means coöperating with the forward end of said first mentioned sleeve to rotate the same, and means securing said driving sleeve to the shaft to prevent longitudinal movement thereon.

In witness whereof, I have hereunto affixed my signature.

JOHN W. APPLIN.

Sept. 11, 1923. 1,467,641

L. J. JOHNSON

OUTBOARD MOTOR FOR SMALL CRAFT

Filed Jan. 27, 1922 3 Sheets-Sheet 1

Fig. 1.

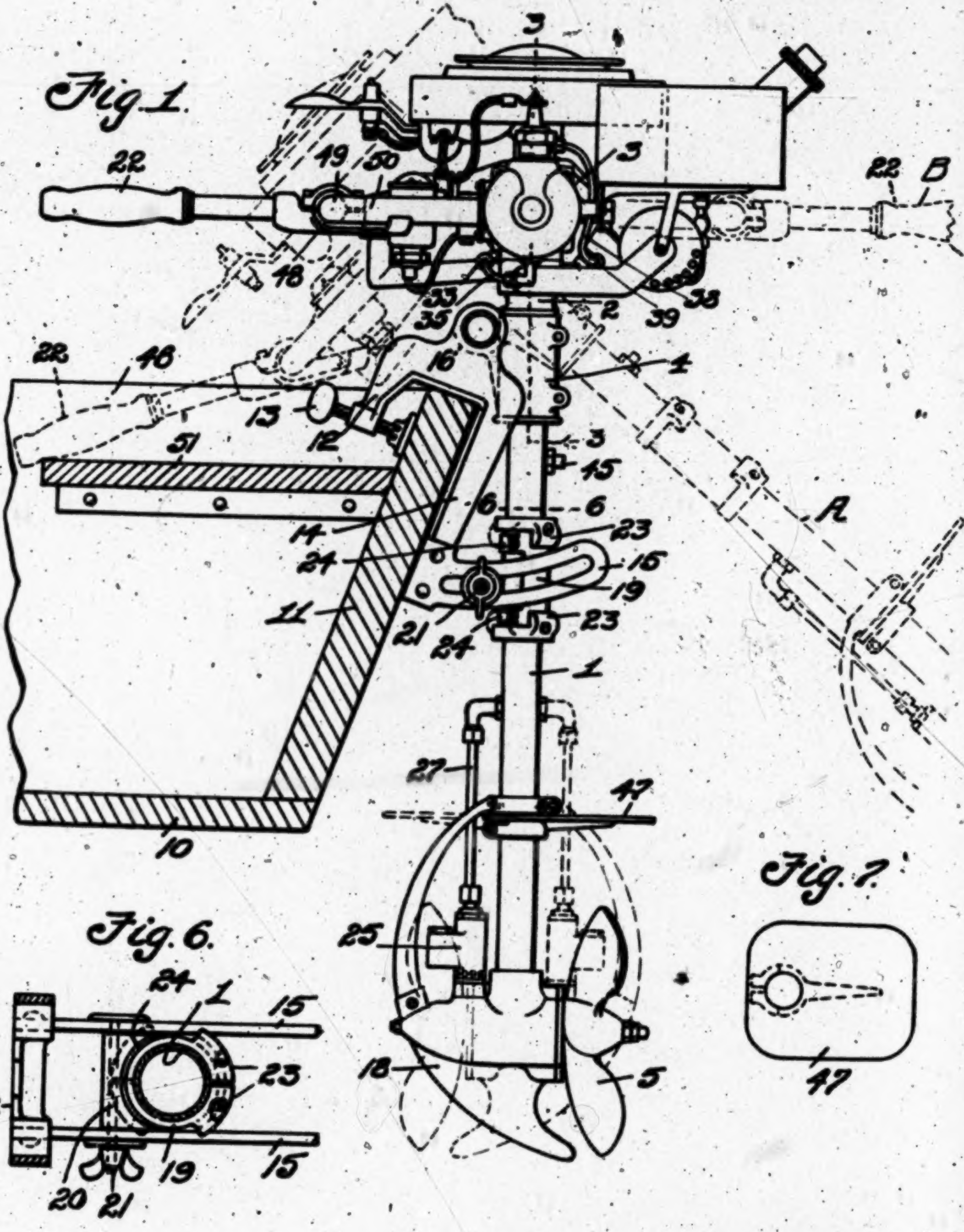

Fig. 7.

Fig. 6.

INVENTOR.

Louis J. Johnson

BY George J. Oltsch

ATTORNEY.

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Sept. 11, 1923. 1,467,641

L. J. JOHNSON

OUTBOARD MOTOR FOR SMALL CRAFT

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Fig. 2.

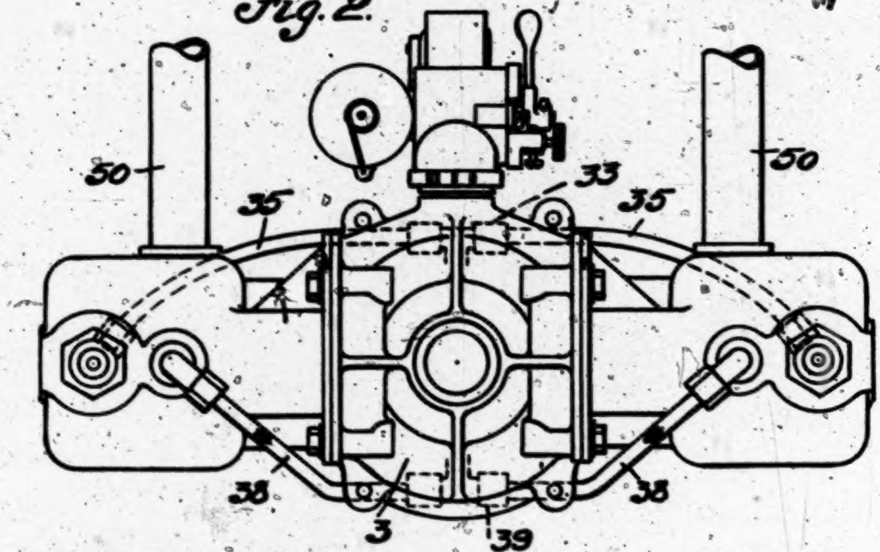
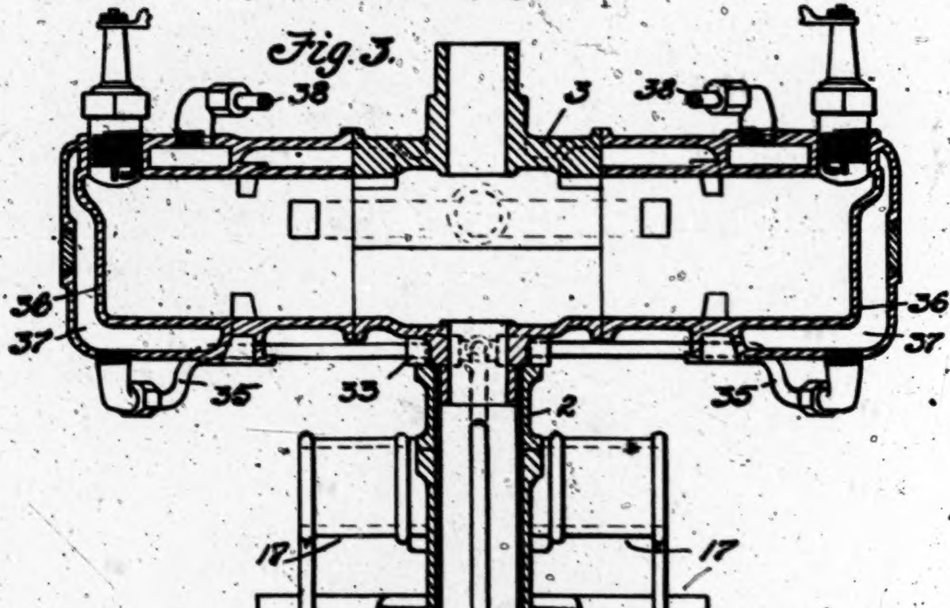


Fig. 3.



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Sept. 11, 1923. 1,467,641

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OUTBOARD MOTOR FOR SMALL CRAFT

Filed Jan. 27, 1922 3 Sheets-Sheet 3

Fig. 4.

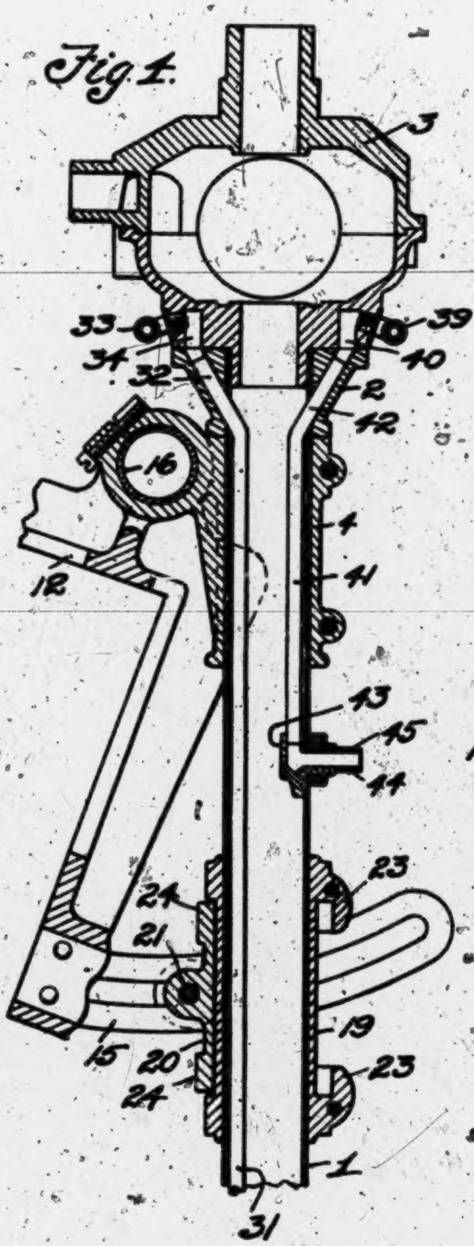
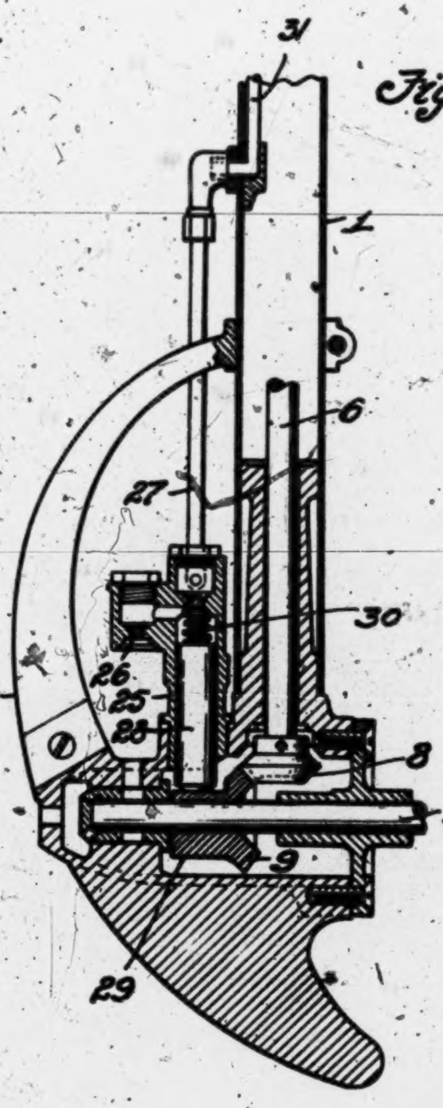


Fig. 5.



INVENTOR.

Louis J. Johnson

BY George J. Oltsch

ATTORNEY.

Patented Sept. 11, 1923. **1,467,641**

UNITED STATES PATENT OFFICE.

LOUIS J. JOHNSON, OF MISHAWAKA, INDIANA, ASSIGNOR TO JOHNSON BROS. ENGINEERING CORPORATION, OF SOUTH BEND, INDIANA.

OUTBOARD MOTOR FOR SMALL CRAFT.

Application filed January 27, 1922. Serial No. 532,340.

To all whom it may concern:

Be it known that I, LOUIS J. JOHNSON, a citizen of the United States, residing at Mishawaka, in the county of St. Joseph and State of Indiana, have invented certain new and useful Improvements in Outboard Motors for Small Craft, of which the following is a specification.

The invention relates to out-board motors for small craft, and has for its object to provide a device of this character which is pivoted to a detachable bracket carried by the gunwale, and pivotally mounted in a sleeve in such a manner that the device may be moved entirely around or for 360 degrees in a horizontal plane. Also to provide the attaching bracket with outwardly extending slotted arms concentric with the pivotal point of the device with the detachable bracket, said arms having adjustably mounted therebetween a segmentally shaped plate, which plate limits the forward movement of the tubular shaft casing and at the same time allows the tubular shaft casing and the device as a whole to be tilted in a vertical plane.

A further object is to provide the tubular casing with a sleeve having inwardly extending segmentally shaped flanges, which flanges are so positioned that when the tubular casing has been rotated for placing the propeller in reverse position, for instance in backing, the inwardly extending flanges will engage over segmentally shaped ribs on the segmentally shaped plate, thereby holding the device against movement in a vertical plane during a backing operation.

A further object is to provide in connection with a pivoted out-board motor, which motor is pivoted to move in a horizontal plane or a vertical plane and comprising a tubular casing on the upper end of which is mounted a motor, and the lower end provided with a propeller driven by shafting from the motor and extending through the tubular casing, a cooling circuit for the motor substantially entirely encased in such a manner that the piping from the pump located adjacent the propeller passes through the tubular casing to a point above the pivotal points of the device, and thence to the engine jacket. Also to provide a pipe connection to the engine jacket, which pipe connection extends downwardly through the tubular casing and discharges through the tubular casing wall at a point below the gunwale of the boat, and preferably above the water line, thereby preventing discharge of water into the boat when the boat is backing or when the device is being used not only for driving, but for steering purposes.

With the above and other objects in view the invention resides in the combination and arrangement of parts as hereinafter set forth, shown in the drawings, described and claimed, it being understood that changes in the precise embodiment of the invention may be made within the scope of what is claimed without departing from the spirit of the invention.

In the drawings:—

Figure 1 is a sectional view through the stern of a conventional form of row boat, showing the out-board motor applied thereto.

Figure 2 is a top plan view of the motor.

Figure 3 is a vertical sectional view through the motor, and a portion of the supporting bracket and the tubular casing.

Figure 4 is a vertical sectional view through the upper end of the device, showing its supporting sleeve and bracket in section.

Figure 5 is a vertical sectional view through the lower end of the device, showing the pump actuated thereby.

Figure 6 is a horizontal sectional view taken on line 6—6 of Figure 1.

Figure 7 is a top plan view of a plate disposed above the propeller and carried by the tubular casing for preventing cavitation.

Referring to the drawings, the numeral 1 designate a substantially vertically disposed tubular casing, which casing at its upper end has secured thereto a tapered sleeve 2, and supported on the tapered sleeve and on the tubular member 1 is a motor casing 3. The tubular sleeve 1 is pivotally mounted in a sleeve 4, in such a manner that the tubular member may be turned entirely around in the sleeve 4 for reversing the position of the propeller 5 or during a steering operation when the boat is cleared by driving. The tubular casing 1 houses the drive shaft 6, which drive shaft is driven by the motor located within the motor casing 3, which motor may be of any conventional form, however it drives the shaft 6 and thereby drives the propeller shaft 7

through the medium of the bevel gear 8, which bevel gear meshes with the bevel gear 9, carried by the propeller shaft. It will be seen that when the drive shaft 6 is rotated the propeller 5 will be rotated, and that when the tubular casing 1 is rotated in the sleeve 4 substantially 180 degrees, that the propeller 5 will be positioned for reversing the direction of movement of the boat 10, on the stern board 11 of which the motor as a whole is supported by means of the bracket 12. The bracket 12 is provided with a thumb screw 13 which forms means whereby the bracket 12 may be easily and quickly placed in position or removed. The arm 14 of the bracket 12 extends downwardly and terminates in spaced rearwardly extending segmentally shaped arms 15, between which the tubular casing 1 is disposed, and moves. The sleeve 4 is provided with a rearwardly extending apertured lug 16, which is pivotally mounted in the arms 17 of the bracket 12 in such a manner that it may pivot and move in a vertically plane, thereby allowing the lower end of the device to freely move upwardly and rearwardly when the propeller guard 18 comes in engagement with an obstruction or the like, thereby preventing breakage of the device, and at the same tnme allowing the device to rise when going over shoal places.

Secured to the tubular casing 1 and disposed between the segmentally shaped arms 15 is a sleeve 19, the rear face of which engages a segmentally shaped plate 20 disposed between the arms 15, and held in various positions therebetween by means of the bolt 21. The plate 20 may be adjusted inwardly and outwardly to various positions according to the angle of the stern board 11 of the boat, thereby allowing the tubular member to be positioned substantially vertically, and be limited in its forward movement during the propelling operation by the engagement of the sleeve 19 with the plate 20. The segmentally shaped plate however does not prevent the device from being tilted in a vertical plane to the position shown in dotted lines A in Figure 1, or to be positioned in reverse position for backing the boat. However when it is desired to back the boat the operator grasps the handle member 22, rotates the device as a whole until it has been moved substantially 180 degrees, and the handle member 22 moved to the dotted line position B; this action will cause the tubular casing 1 to rotate, and the propeller to be moved 180 degrees to a position where the propeller will cause the boat to back, said position being shown in dotted lines in Figure 1. However it is obvious that when the device is rotated 180 degrees, it will be necessary to provide means for holding the device from rearward movement at its free end. To accomplish this result the sleeve 19 is provided with segmentally shaped flanges 23 which extend toward each other, and which flanges, when the tubular casing 1 is rotated, engaged over segmentally shaped flanges 24 carried by the upper and lower ends of the plate 20, therefore it will be seen that the tubular member and the device as a whole will be held against pivotal action in a vertical plane during the backing operation.

Heretofore in outboard motors the cooling of the motor casing 3 has been accomplished by flexible connections, such for instance as a hose connection between the pump 25 and the engine casing 3. It is obvious that such a connection prevents rotation of the device in its bearings and interferes with the pivoting of the device in a horizontal plane for 360 degrees and interferes with the pivotal action of the device while being used for steering purposes. To overcome this difficulty the water from the pump 25, after being sucked through a check valve 26, is discharged upwardly through the pipe 27. The pump 25 comprises a reciprocating piston 28 actuated by the eccentric collar 29, which forces the piston upwardly thereby compressing the spring 30, which spring maintains the lower end of the piston 28 in engagement with the eccentric collar 29 at all times. The water is forced through the pipe 27, which pipe at a point, preferably slightly above the propeller guard 18 is in communication with a pipe 31 within the tubular casing 1 adjacent one side thereof. The pipe 31 extends upwardly through the tapered sleeve 2 as at 32 at a point above the supporting sleeve 4 and is in communication with a T 33 through the port 34 in the engine casing. It will be seen that the water pumped passes upwardly through the tubular casing 1 past the pivotal and supporting points of the device, thereby eliminating the use of external pipe or flexible hose as is the present practice. Connected to the T 33 are outwardly extending pipes 35, which pipes extend under the cylinders 36 of the engine casing 3 and are in communication with the water jackets 37. The water is forced into the water jackets 37 and passes out of the same through the pipes 38 in communication with the upper sides of the water jackets, which pipes extend downwardly and are connected to the T 39, which is in communication with a port 40 in the engine casing 3, and through which port the water passes to the pipe 41, disposed within the tubular casing 1 and having its upper end 42 extending through the tapered sleeve 2 and its lower end disposed in the upwardly extending arm 43 of a discharge L 44, the arm 45 of which extends through the tubu-

lar casing 1 at a point below the gunwale 46 of the boat, thereby discharging the cooling water at a point where it will not blow into the boat or be discharged into the boat when the device is pivoted in its bearings during a steering operation.

The lower end of the tubular member 1 is provided with a horizontally disposed plate 47, which prevent cavitation, especially when the device is being used on the gunwales of the boat. The device is provided with a pivoted handle, said handle being designated by the numeral 22 and pivoted at 48 on the transverse portion 49 of a U-shaped member 50 carried by the engine casing. By pivoting the handle 22 it will be seen that if the propeller guard 18 hits an obstruction and the device is suddenly pivoted in a vertical plane that if the handle member 22 comes into engagement with an obstruction, such for instance as the rear seat 51, that a pivotal action will be taking place at 48, as clearly shown in dotted lines in Figure 1, thereby preventing breakage of the device and allowing full swing of the motor and device without interference from the operating handle.

From the above it will be seen that an out-board motor is provided which is simple in construction, movable in a vertical plane and so constructed that it may be continuously rotated in a horizontal plane in either direction without interference from flexible pipe connections between the pump and the water jackets of the engine cylinders.

The invention having been set forth what is claimed as new and useful is:—

1. An out-board motor comprising a vertically disposed tubular member, said tubular member adjacent its upper end being pivotally mounted in a collar, a bracket for supporting said collar and to which bracket the collar is pivoted, a limiting member engaging the inner face of the tubular member, means for adjusting said limiting member, means carried by the tubular member and interlocking with the limiting member when the tubular member is rotated, a propeller carried by the tubular member adjacent its lower end, a motor carried at the upper end of the tubular member and means for driving the propeller from the motor through the tubular member.

2. The combination with a pivoted out-board motor pivoted to a bracket carried by a boat, said motor driving a propeller through a tubular casing, of spaced arms between which the tubular member is disposed, an adjustable limiting member disposed between the arms and adjustable inwardly and outwardly and members carried by the tubular casing and adapted to engage members carried by the limiting member and prevent movement of the tubular member pivotally in a vertical plane upon movement of the tubular member in a horizontal plane.

3. The combination with a pivoted tubular casing supporting a motor and a propeller and having driving mechanism through the casing from the motor to the propeller, said tubular casing being pivotally movable in a horizontal plane and in a vertical plane, of means for limiting the movement of the casing inwardly and allowing movement of the casing in a vertical plane, and means whereby upon a movement of the tubular casing in a horizontal plane it will be locked against pivotal movement in a vertical plane.

4. The combination with the vertical casing of an out-board motor, said casing being movable pivotally in a vertical and a horizontal plane, of means for preventing the movement of said vertical casing, said means comprising spaced arms having slots therein, said casing being disposed between said arms, an adjustable plate between the arms with which one side of the casing engages and is limited in its movement, a flange carried by the casing and segmentally shaped, a segmentally shaped member carried by the plate and positioned whereby it will be engaged and held by the flange carried by the casing upon a partial rotation of the casing.

5. The combination with an out-board motor pivoted to move in a horizontal and in a vertical plane, of means for limiting the downward movement in a vertical plane and means cooperating with the first mentioned means for preventing movement upwardly in a vertical plane upon a partial pivotal movement of the motor.

6. The combination with an out-board motor pivoted to move in a vertical plane or in a transverse plane, of means below the pivotal point for limiting the downward movement of the free end of the motor, and means whereby upon a partial rotation of the motor the upward movement of the free end thereof will be prevented.

7. The combination with an out-board motor comprising a vertically disposed tubular propeller drive shaft casing pivotally mounted, a motor carried by the upper end of said casing and having a water jacket, a pump disposed adjacent the lower end of the casing and actuated from the motor, of a pipe connection between the pump and the water jacket of the motor and passing through the vertically disposed propeller drive shaft casing, a discharge pipe connected to the water jacket, said discharge pipe extending downwardly through the tubular propeller drive shaft casing and discharging through the wall of propeller drive shaft casing.

8. The combination with an out-board motor comprising an engine having a water

jacket, a pivoted tubular propeller drive shaft casing supporting said engine, a propeller at the lower end of the tubular propeller drive shaft casing and driven from the motor, a pump driven by the propeller driving mechanism, a pipe connection between the pump and the water jacket of the engine, said pipe passing through the tubular propeller drive shaft casing, a pipe connection between the water jacket and extending downwardly through the tubular propeller drive shaft casing and discharging through the side thereof.

9. The combination with an out-board motor comprising an engine supported on a tubular propeller drive shaft casing and cooled from a pump adjacent the lower end of the tubular casing, of a pipe connecting the pump and the engine cooling system, said pipe extending through the tubular propeller drive shaft casing to one side of the center of the casing.

10. The combination with an out-board motor comprising a motor casing having a water jacket and spaced intake and discharge ports, said casing being detachably supported on the upper end of a tubular propeller drive shaft casing, a pump located adjacent the lower end of the tubular propeller drive shaft casing, of supply and discharge pipes disposed within the drive shaft casing, the upper ends of the pipes being in registration with the ports of the engine casing, one of said pipes being in communication with the pump.

11. The combination with an outboard motor pivoted to turn axially of its propeller shaft and to swing bodily in a vertical plane, of means for limiting the downward movement in a vertical plane, and means adapted upon a directional movement of the propeller to engage the first mentioned means to lock the movement of the propeller in a vertical plane.

12. The combination with a motor including a propeller and a propeller drive shaft adapted to move in a horizontal plane and in a vertical plane, of means controlled in the angular adjustment of the propeller for locking the latter against movement in a vertical plane.

13. The combination with a motor, of a tubular casing supporting a propeller, driving connections between the motor and the propeller through the casing, said tubular casing being movable axially and in a vertical plane, and means whereby upon an axial turning of the casing it will be locked against movement in a vertical plane.

In testimony whereof I affix my signature.

LOUIS J. JOHNSON.

492
Oct. 14, 1924.

1,511,867

D. F. ASBURY

MARINE PROPULSION APPARATUS

Original Filed Sept. 13, 1920

2 Sheets-Sheet 1

Fig. 1.

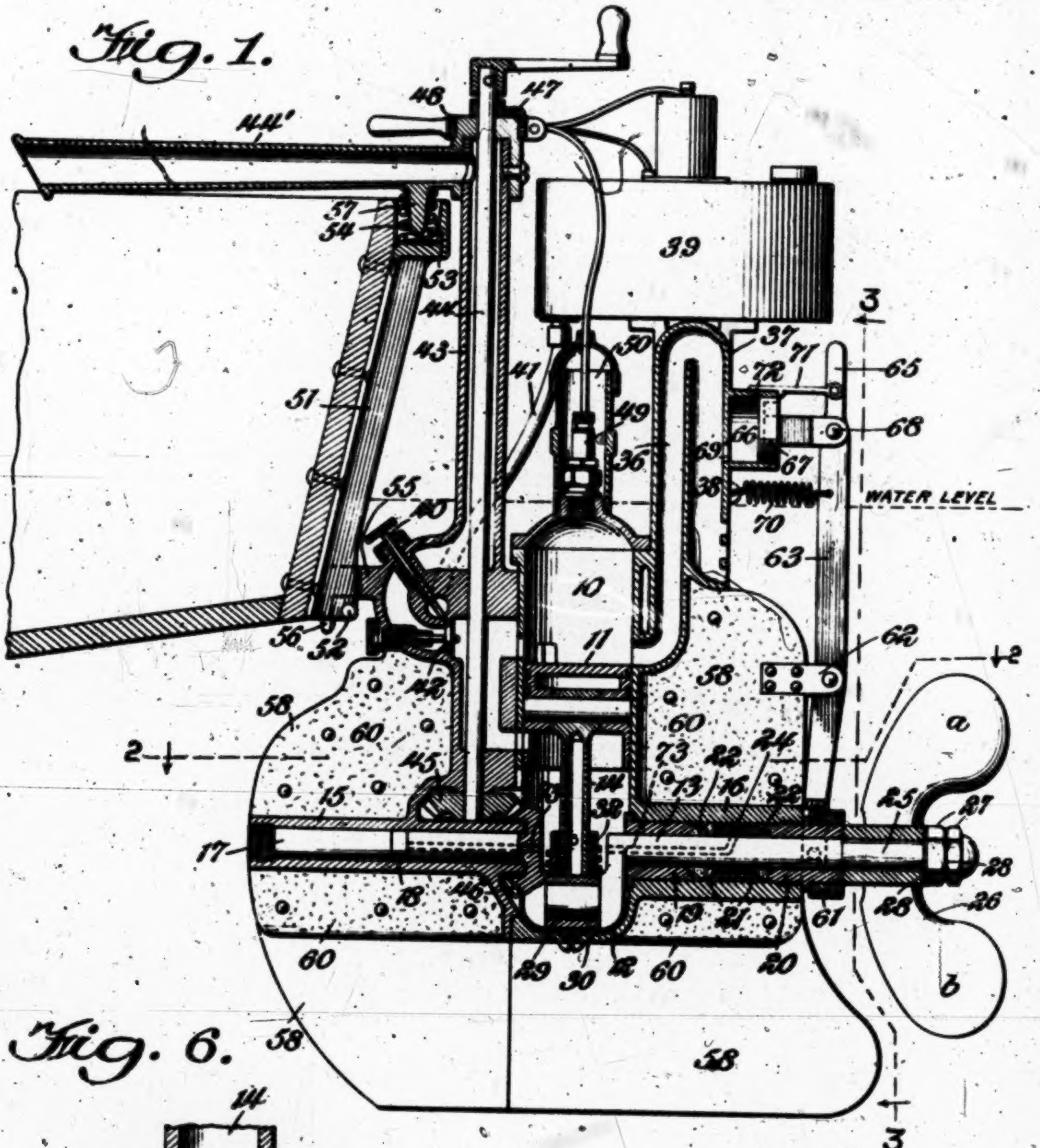


Fig. 6.

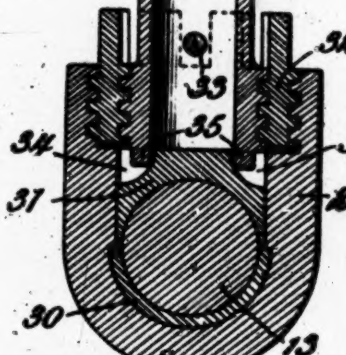
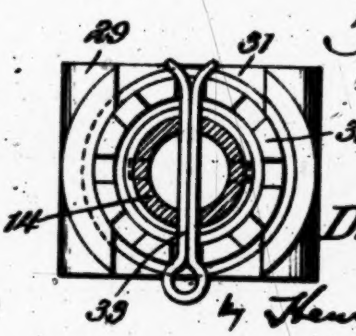


Fig. 7.



Inventor
D. F. Asbury,
by Henry F. Bright
Attorney

494

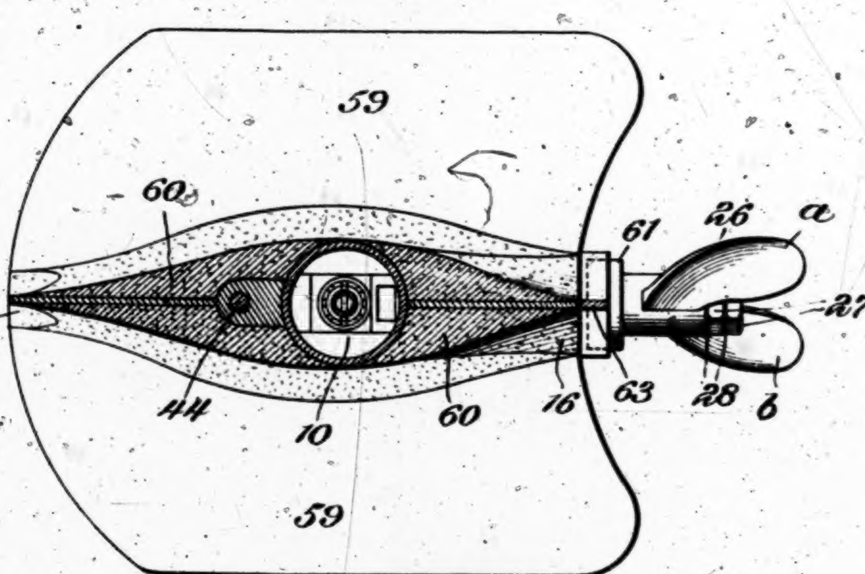
Oct. 14, 1924. 1,511,867

D. F. ASBURY

MARINE PROPULSION APPARATUS

Original Filed Sept. 13, 1920 2 Sheets-Sheet 2

Fig. 2.



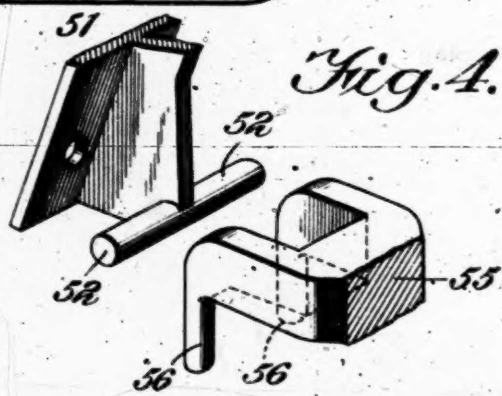


Fig. 4.

Fig. 3.

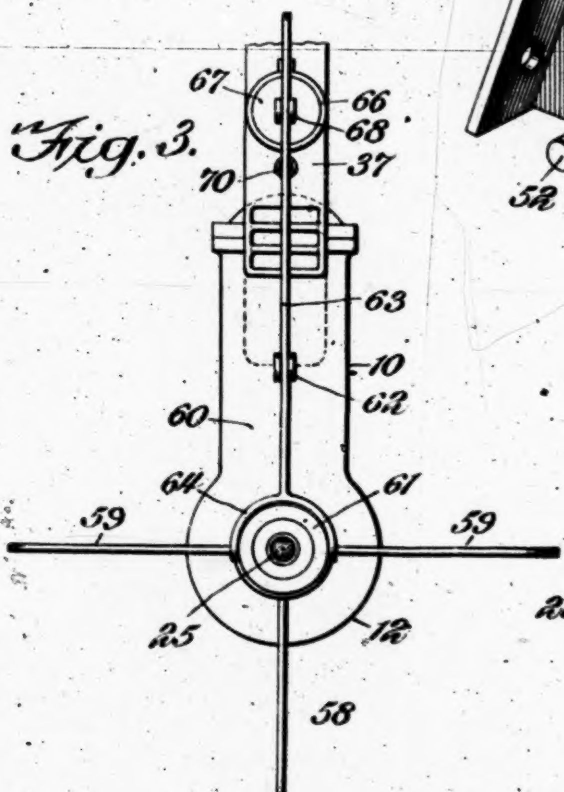


Fig. 5.

Inventor,

D. F. Asbury,

Henry T. Bright

Attorney

Patented Oct. 14, 1924. 495 1,511,867

UNITED STATES PATENT OFFICE.

DORSEY FROST ASBURY, OF WASHINGTON, DISTRICT OF COLUMBIA.

MARINE PROPULSION APPARATUS.

Application filed September 13, 1920, Serial No. 409,822. Renewed August 16, 1922. Serial No. 582,247.

To all whom it may concern:

Be it known that I, Dorsey F. Asbury, a citizen of the United States, and resident of Washington, in the District of Columbia, have invented certain new and useful Improvements in Marine Propulsion Apparatus, of which the following is a specification.

My invention relates to marine propulsion apparatus and has particular reference to improvements in outboard or portable motors of the type embracing in a single small unit a complete propelling mechanism, my purpose being to overcome some of the more noteworthy disadvantages encountered and manifested in the use of present types of motors of this character.

It is well known that present types of outboard motors subject the craft to which they are attached to excessive vibration which is not only extremely disagreeable to the craft's occupants, but is harmful to the craft itself, and it is one of the important objects of my invention to overcome this objectionable feature by providing a motor of such construction and manner of arranging and connecting it with a craft that vibration of the craft due to operation of the motor will be eliminated.

In accomplishing the foregoing I have been enabled to eliminate considerable of the noise and racket resulting from operation of prior types of outboard motors; to provide a clean, out of sight, light weight motor of greatest efficiency because its power is delivered direct to the propeller; to overcome the "run around" effect of outboard motors and provide for automatic straight steering; and to minimize the number of essential parts and mechanisms, and provide a compact apparatus easily assembled and unlikely to get out of order.

The features of novelty whereby I am able to accomplish the foregoing are susceptible of embodiment in various mechanical structures and uses such as are illustrated in the accompanying drawings, but it is to be understood that the structures shown are merely intended to disclose the essential features of my invention in a preferred form and that the scope of my invention is as defined in the appended claims.

In the drawings, wherein like characters of reference denote corresponding parts in the different views—

Fig. 1 is a central vertical section through my improved propelling apparatus showing the same connected to a craft;

Fig. 2, a horizontal section on the line 2—2 of Fig. 1;

Fig. 3, a transverse section on the line 3—3 of Fig. 1;

Fig. 4, a detail perspective showing the manner of connecting the motor with the craft;

Fig. 5, a detail perspective showing the relative arrangement of the packing rings for the power shaft;

Fig. 6, an enlarged section of the connection between the connecting rod and the crank shaft; and

Fig. 7, a plan of what is shown in Fig. 6.

Referring to the drawings in detail, it will be observed that my improved propulsion apparatus consists of an explosion motor including essentially a cylinder 10, piston 11, crank case 12, crank shaft 13 and connecting rod 14. To facilitate the construction and assembly of this motor the same is preferably embodied in two main parts, that part including the cylinder, crank case proper, and other parts, and a second part adapted to be bolted or otherwise secured to the first part and including the fuel mixing devices and the housing for the timer shaft, timer gears etc. The motor is preferably of the two cycle type in which the explosive mixture is forced into the explosion chamber by being first compressed in the base or crank case 12, and said crank case includes fore and aft housings 15 and 16, respectively within which the crank shaft finds bearings, the housing 15 being plugged by a member 17 and a bearing or block 18 of lignum-vitæ or other suitable material being interposed between the inner end of this member and the adjacent end of the crank shaft to receive the end thrust imparted to said crank shaft in motors of this type, wherein the propeller is secured directly to the crank shaft.

The rearwardly extending portion of the crank shaft 13 projects through spaced bearing sleeves 19 and 20 fixed in the housing 16, the latter sleeve projecting slightly beyond the end of said housing as shown, and between said bearing sleeves are arranged a pair of gland rings 21, and between each of these gland rings and the adjacent end of the respective bearing sleeves is arranged packing material 22. Each gland ring has

formed thereon a plurality of spaced fingers 23 and the fingers of the respective rings are adapted to intermesh and enclose the crank shaft at the point where a cavity exists between the rings due to their relative spaced arrangement. These fingers serve to prevent a number of coil springs 24, arranged between the gland rings to maintain them properly engaged with the packing 22, from contacting with the shaft, plural springs being used to assure even pressure of the rings against the packing, which packing is for the purpose of preventing water from leaking around the shaft and finding its way into the crank case of the engine. The shaft is reduced in diameter as at 25 where it extends beyond the end of the bearing sleeve 20, to receive the hub of a propeller 26, which is keyed to said reduced end of the shaft and is additionally secured thereon by nuts 27, one of which serves as a lock for the other, and between the inner propeller securing nut and the propeller and between the nuts themselves are arranged felt or other similar gaskets or washers 28 to prevent leakage around the reduced portion of the shaft. It will thus be noticed that there is a running fit or contact between adjacent ends of the sleeve 20 and the hub of the propeller and that this is the only point where it is possible for water to gain access to the crank shaft, and then only when the engine is in operation, since means has been provided which will be particularly described hereinafter to prevent leakage at this point when the engine is idle.

My motor is designed to be water cooled and is adapted to operate when submerged, being therefore jacketless, and as it travels in water it is important that its bulk be reduced to a minimum in order to offer the least resistance to its progress. I have therefore designed a novel means of connecting the crank shaft with the connecting rod 14 so that the crank case may be reduced to the smallest practicable size. This connecting means embodies a substantially U-shaped block 29, arranged to embrace the crank pin of the crank shaft 13, and provided at its connecting or bight portion with a bearing 30 for the crank pin. Adapted to be inserted between the legs of the block 29 is a shoe 31, forming the second half of the bearing for the crank pin. The lower end of the connecting rod 14 is externally threaded and the legs of the U-block are internally threaded, the threaded portion of the rod being somewhat smaller in diameter than the threaded portion of the block, and the end of the connecting rod is adapted to be inserted between the legs of the block into contact with the shoe 31 and a nut 32, having internal threads, engaged with the threaded portion of the rod, and external threads, for engagement with the threads of the legs of the U-block, is then rotated to engage said last mentioned threads to secure all of said parts together and in place, where they are locked by a cotter pin 33 passing through the connecting rod and received in recesses in the nut. In order to prevent rotation of the connecting rod the shoe 31 has one or more recesses 34 cut in its upper face and the lower end of the rod has a gib or lugs 35 for engagement in these recesses, and while this is a preferred construction it is apparent that the arrangement might be reversed by recessing the rod and providing lugs or gibs on the shoe, or the desired result might be accomplished in some other manner. To disconnect the rod from the block it is only necessary to remove the cotter and then rotate the nut to disengage the threads between it and the legs of the block, whereupon the block, shoe, rod, and nut may be readily relatively separated and also removed from the crank pin.

The exhaust from the motor passes upward through a passage 36 in a casting 37, formed either integral with or separate from the cylinder 10, and thence downward through a second passage 38 in said casting, and finally out through the open end of said second passage, the casting 37 serving as a support for a fuel tank 39 which in turn acts as a support for the coil and batteries of the ignition system for the engine.

Suitably arranged in the second main part of the engine is a fuel regulating needle valve 40, to which fuel is supplied from the tank 39 through a pipe 41, and also arranged in said second main part of the engine, adjacent to the valve 40, is an air valve 42 to which air is supplied through a hollow vertically arranged steering column 43, to the upper end of which is secured a hollow tiller 44, whereby air may enter said column. By this arrangement the operator of the apparatus may grasp the tiller in the usual manner to hold the motor steady when it is desired to start the same, and with the same hand may partially or fully close the air entrance end of the tiller to thereby choke the air supply to the motor and thus facilitate the starting operation.

Extending through the column 43 is a shaft 44 which carries a bevel gear 45 at its lower end arranged in meshing relation with a similar gear 46 formed on the crank portion of the crank shaft 13. The upper end of this shaft carries a contact making and breaking device 47, operating in conjunction with a timer 48 carried by an adjacent portion of the column or tiller, for producing at proper times a spark in the plug 49 in the head of the cylinder 10, the plug being encased by a water tight housing 50, and the upper end of the shaft 44 being additionally

provided with means whereby it may be utilized to impart rotation to the crank shaft through the gears 45 and 46 for starting the engine.

My apparatus, as described in the foregoing, is particularly adapted for the propulsion of small craft, although susceptible of use for various other purposes, but when used for the former purpose is adapted to operate when submerged, being connected with and supported by the craft in a novel and peculiar manner whereby the objects set forth in the beginning of this specification are accomplished.

The manner of connecting the apparatus with the craft includes means whereby the apparatus is yieldably supported for movement in all transverse directions, said means consisting of a bracket 51 of T-shaped cross section secured to the craft and carrying at its lower end a pair of oppositely disposed lateral lugs 52 which are spaced from the craft, while at its upper end it is provided with a socket 53 to receive a coiled vertically acting compression spring 54. The engine has secured thereto or formed thereon a bifurcated member 55 including a pair of relatively spaced downwardly extending legs 56 adapted to straddle and cooperate with the lugs 52 to connect the apparatus with the craft, and the tiller 44′ carries a downwardly extending lug 57 adapted to be received interiorly of the coil spring 54 whereby the apparatus is yieldably supported when the motor is in operation the forward portion of the legs 56 contact with the bracket 51 on the craft, whereby the craft is pushed forward, and when the motor is reversed said legs engage the lugs 52 to exert a pull to move the craft rearwardly. The legs 56 are so relatively disposed with respect to the longitudinal axis of the motor as to compensate the "run around" tendency of the propeller to thereby assure straight steering of the craft at all times except when the apparatus is swung by means of the tiller 44′ upon the lug 57 as a pivot to effect turning of the craft.

It is well known that the principal vibration of a motor of the type shown in the drawings is in the plane of rotation of its crank shaft, and while the yieldable connection between the craft and motor serves to relieve the craft of considerable of the motor's vibration, the motor itself being prevented from vibrating to any appreciable extent by means of fore and aft vertical and horizontal fins or blades 58 and 59, respectively, secured to the motor in any preferred manner, and adapted to operate against the water's inertia to hold the motor steady. Preferably, the motor and these fins or blades have secured thereto bouyant material 60 of cork or the like whereby the craft is relieved of a portion of the weight of the apparatus, and this material is of streamline contour or shape in order that the apparatus as a whole may offer the least resistance to its progress through the water.

I have provided means operable both manually and automatically to prevent leakage of water between the sleeve 20 and the hub of the propeller. This means preferably consists of a flexible band 61, slidable on the projecting end of the sleeve 20 and the surface of the propeller hub which is alined therewith. A bracket 62 is secured to one of the blades or fins 58 and to this bracket is pivoted an intermediate portion of a lever 63, one end of which is formed into a yoke 64, connected to the flexible band 61, whereby movement of the lever will slide the band on the sleeve and hub, while the other end is provided with a handle or grip 65 whereby it may be manually operated. Formed on the exhaust casting 37 is a cylindrical extension 66 and fitting this extension is a plunger 67, connected to the lever near its handle, as at 68. A small port or opening 69 is provided in the exhaust casting to permit a portion of the exhaust products to enter the cylindrical extension and act against the plunger during operation of the engine to move and hold the lever outward and consequently move and hold the band out of engagement with the hub of the propeller to permit free rotation of the latter. When the engine is stopped, however, exhaust pressure against the plunger ceases and a contractile coil spring 70 which connects the lever with the exhaust casing is then free to act to automatically move the lever to dispose the band in covering relation with adjacent portions of the sleeve 20 and the hub of the propeller whereby leakage at this point is prevented. It is thus apparent that when the engine is idle the sleeve is disposed in contact with a rotatable part of the apparatus, thus rendering the engine hard to start until the sleeve has been moved out of contact with such rotatable part, and therefore, inasmuch as it is impracticable for the operator to manually hold the lever in position to dispose the sleeve out of contact with the propeller hub and at the same time perform other operations incident to starting, means consisting of a latch member 71 pivoted to the lever and engageable with the cylindrical extension has been provided to accomplish this purpose. Thus, just prior to starting the engine the lever 65 is moved outward until the latch 71 engages with the cylindrical extension to hold the band out of contact with the propeller hub. The apparatus is then free to be operated and the engine is started, whereupon part of the exhaust products entering chamber 66 escapes through a small opening 72 in the cylindrical extension and constantly acts against a portion of the latch to hold the

same out of engagement with the cylindrical extension. When the latch is released incident to starting the engine, however, the lever 65 remains in an outwardly disposed position due to the action of the exhaust against plunger 67, but when the engine is stopped, and the pressure of the exhaust against the plunger diminishes and finally ceases, the spring 70 then acts to restore the normal relation of parts, it being understood that although the diminishing exhaust pressure is incapable of holding the plunger 67 out against the action of the spring 70, it is sufficiently strong to hold the latch raised until the lever has moved inward far enough to render its dropping ineffective to prevent the lever's complete inward movement. On the other hand, it will be apparent that should the engine be started without the band having first been moved from contact with the propeller hub, as previously stated, this will be accomplished by the exhaust acting against the plunger 67 as soon as the engine fires.

From the foregoing it will be noted that when the motor is idle water cannot leak into the crank case, but that when the motor is running water may find its way to the crank shaft, and this will ordinarily be prevented from entering the crank case by packing 22, but to further guard against such leakage I provide the crank shaft with a small longitudinal opening 73 leading from the crank case to the bearing block 18 and to the cavity between the gland rings 21 so that the gases to be exploded, which have a higher average pressure than the pressure of the water, may find their way to the shaft bearings to exclude water from the crank case and also serve as a means of lubricating said shaft and its bearings as well as the packing 22.

The blade *a* of the propeller is constructed heavier than the blade *b* so as to balance the crank of the motor and further assure its smooth operation.

It is believed that the numerous advantages flowing from my improved propelling apparatus, as constructed in accordance with the foregoing, will be readily appreciated and that its operation will be apparent without further detailed description. I desire to point out, however, that the apparatus may be removed from the craft by simply lifting it vertically and that it may be supported above the water by one of the legs 52 being engaged with the socket 53, and further, that when lowering it into the water the bracket 51 will act as a guide and bearing to properly engage it with the craft.

I claim:—

1. In apparatus of the character described, a craft including steering means, and spaced laterally disposed contact points between the craft and steering means movable selectively into and out of engagement with the craft, said contact points being slidable with respect to the craft.

2. In marine propulsion apparatus, the combination with a craft, of a submerged motor yieldably supported by said craft for propelling the same, and a pair of relatively spaced contact points between the craft and motor, both of said contacts being normally in engagement with the boat and being movable singly and selectively into and out of engagement with the craft.

3. In marine propulsion apparatus, the combination with a craft, of a submerged motor yieldably supported against said craft in directions at right angles to the latter for pushing and pulling the same, and a pair of loose relatively spaced contacts between said craft and motor, both of said contacts being normally in engagement with the craft, during both pushing and pulling of the same and movable singly and selectively into engagement with the craft.

4. In marine propulsion apparatus, the combination with a craft and an internal combustion engine for propelling the same, said engine including means for mixing fuel with air, of a hollow tiller leading to said mixing means for supplying air thereto.

5. In marine propulsion apparatus, the combination with a craft and a submerged internal combustion engine for propelling the same, said engine including means for mixing fuel with air, of a hollow steering column leading to said mixing means, and a hollow tiller connected with and communicating with said hollow steering column, whereby air is supplied to said mixing means.

6. In marine propulsion apparatus, the combination with a submerged motor having fins to absorb its vibration, of bouyant material of stream-line shape carried by said fins and acting to relieve the support for said motor of a portion of its weight.

7. In apparatus of the character described, a craft including steering means, spaced laterally disposed contact points between the craft and steering means movable selectively into and out of engagement with the craft, and means for propelling said craft, said propelling means acting when in operation to hold said contact points in engagement with the craft.

8. In marine propulsion apparatus, the combination with a craft, of a motor for propelling the same, and a contact between the motor and a surface of the craft, said contact being yieldable in all directions over said surface, whereby vibrations of the motor are prevented from being transmitted to the craft.

9. In a submerged motor having a shaft extending into the water surrounding the

motor, members on the shaft and motor respectively whose surfaces are substantially in alinement, and an elastic tube binding against adjacent portions of said members to prevent leakage therebetween.

10. In a submerged motor having a shaft extending into the water surrounding the motor, a stationary member on the motor, a member on the shaft rotatable therewith, and a device binding against adjacent portions of said members when the motor is idle to prevent leakage of water into the motor, and means for moving said device out of binding relation with one of said members.

11. In a submerged motor having a shaft extending into the water surrounding the motor, a stationary member on the motor, a member on the shaft rotatable therewith, and a device binding against adjacent portions of said members when the motor is idle to prevent leakage of water into the motor, and automatic means for moving said device out of binding relation with one of said members when the motor is in operation.

12. In a submerged motor having a shaft extending into the water surrounding the motor, a stationary member on the motor, a member on the shaft rotatable therewith, and a device binding against adjacent portions of said members when the motor is idle to prevent leakage of water into the motor, and means operated by the exhaust from said motor for moving said device out of binding relation with one of said members when the motor is in operation.

13. In a submerged motor having a shaft extending into the water surrounding the motor, a stationary member on the motor, a member on the shaft rotatable therewith, and a device binding against adjacent portions of said members when the motor is idle to prevent leakage of water into the motor, means operated by the exhaust from said motor for moving said device out of binding relation with one of said members when the motor is in operation, and automatic means for moving said device into binding relation with adjacent portions of said members when the exhaust ceases.

14. In a submerged motor having a shaft extending into the water surrounding the motor, a stationary member on the motor, a member on the shaft rotatable therewith, a device movable into and out of binding relation with one of said members and into and out of binding relation with adjacent portions of both of said members, means for manually moving said device out of binding relation with adjacent portions of said members, a spring constantly urging said device into binding relation with adjacent portions of said members, and a latch member for holding said device out of binding relation with adjacent portions of said members, said latch being releasable by the exhaust from said engine to permit said spring to act.

15. Apparatus of the character described including a motor of the reciprocating piston type adapted to operate when submerged, and blades rigidly connected to said motor and extending at an angle to the direction of reciprocation of the piston and adapted to act against the water in which the motor may be submerged to counteract vibrations due to the reciprocation of the piston.

16. In marine propulsion apparatus, the combination with a craft, of means for propelling and steering the same, and a connection between the craft and said propelling and steering means including a spring yieldable in all directions for supporting the propelling and steering means upon the craft.

17. In marine propulsion apparatus, the combination with a craft, of means for propelling the same, and a connection between the craft and propelling means including a spring yieldable in all directions for supporting the propelling means upon the craft.

18. In marine propulsion apparatus, the combination with a craft, of means for steering the same, and a connection between the craft and said steering means including a spring yieldable in all directions for supporting the steering means upon the craft.

19. In apparatus of the character described, a craft including steering means, and spaced laterally disposed contact points between the craft and steering means movable selectively into and out of engagement with the craft.

20. In apparatus of the character described, a craft including steering means, spaced laterally disposed contact points between the craft and steering means movable selectively into and out of engagement with the craft, and means for holding said contact points in engagement with the craft.

21. In apparatus of the character described, a craft including steering means, a pair of oppositely disposed lugs on said craft, and a bifurcated member including legs engageable with said lugs to flexibly secure the steering means to the craft, said legs being movable selectively into and out of engagement with the craft when the steering means is turned relatively thereto.

22. In apparatus of the character described, a craft including steering means, a pair of oppositely disposed lugs carried by and spaced from the craft, and a bifurcated member carried by the steering means and including laterally spaced legs having angularly extending extremities engageable with said lugs to flexibly secure the steering means to the craft, said legs being movable selectively into and out of engagement with the craft.

23. In marine propulsion apparatus, the combination with a craft, of a motor for

propelling the same and a contact between the motor and a surface of the craft, said contact being slidable in all directions over said surface, whereby vibrations of the motor are prevented from being transmitted to the craft.

24. In marine propulsion apparatus, a craft including steering means, and a contact between said steering means and a surface of the craft, said contact being movable in all directions over said surface.

25. In marine propulsion apparatus, a vertically disposed submergible motor of the reciprocating piston type having laterally disposed blades secured thereto adapted to act against the water in which the motor may be submerged to counteract vibrations due to the reciprocation of the piston.

26. The combination with a driving member, of a device forming a seal to prevent leakage of fluid around said member when the same is idle, and means whereby said seal is maintained broken when the member is in operation.

27. The combination with a driving member, of a device forming a seal to prevent leakage of fluid around said member when the same is idle, means whereby said seal is maintained broken when the member is in operation, and other means acting to prevent leakage of fluid around said member when the same is in operation.

28. The combination with a rotatable member, of a device to prevent leakage of fluid therearound, said device being in contact with said member when the same is idle and being out of contact therewith when the same is running.

29. The combination with a rotatable member, of a device to prevent leakage of fluid therearound, said device being in contact with said member when the same is idle and being moved out of contact therewith automatically when the same is running.

30. In a propulsion apparatus, a fluid body, a shaft extending into said fluid body and carrying a propeller and a seal preventing the leakage of fluid around said shaft when the propeller is idle, said seal being automatically broken when the propeller is in operation.

31. In a propulsion apparatus, in combination, a fluid body, a shaft extending into said fluid body and carrying a propeller, a seal preventing the leakage of fluid around said shaft when the propeller is idle, said seal being automatically broken when the propeller is in operation, and other means to prevent leakage around said shaft when the propeller is in operation.

32. In a propulsion apparatus, a motor, a fluid body, a shaft extending from said motor into said fluid body and carrying a propeller, and a seal preventing the leakage of fluid around said shaft when the motor is idle, said seal being automatically broken when the motor is in operation.

33. Marine propulsion apparatus including a submergible motor having a crank shaft and a crank case, a seal preventing the leakage of water around the shaft into the case when the motor is idle, and means whereby said seal is broken when the motor is started, and maintained broken while the motor is running.

34. In a propulsion apparatus, a motor, a fluid body, a shaft driven from said motor and extending into said fluid body, a seal preventing the leakage of water around said shaft when the motor is idle, and means whereby said seal is broken automatically by the pressure of the exhaust from the motor when the latter is started and maintained broken during operation of the same.

35. In marine propulsion apparatus, the combination with a craft, of propelling means operatively connected to said craft for yielding movement in all directions with respect thereto.

36. In marine propulsion apparatus, the combination with a craft, of means for propelling the same, and a connection between the craft and propelling means including a member yieldable in all directions for supporting the propelling means upon the craft.

37. The combination with a craft, of an outboard motor, and means for operatively connecting the two whereby the motor may yield in all directions with respect to the craft.

38. In marine propulsion apparatus, a submerged motor having a propeller shaft extending exteriorly thereof, a spring, a member, means with which said member coacts under the influence of said spring to provide a seal preventing the leakage of fluid around said shaft into the motor when the latter is idle, and means acting automatically to break said seal when the motor is started.

39. Marine propulsion apparatus including a submergible explosion motor having a crank shaft and a crank case, a seal preventing the leakage of water around the shaft into the crank case when the motor is idle, means whereby said seal is maintained broken when the motor is running, and means whereby leakage of water around the shaft into the crank case is prevented when the seal is broken during operation of the motor.

In testimony whereof I hereunto affix my signature in the presence of two witnesses

DORSEY FROST ASBURY.

Witnesses:
JOHN H. SIGGERS,
FLORENCE A. BLINN.

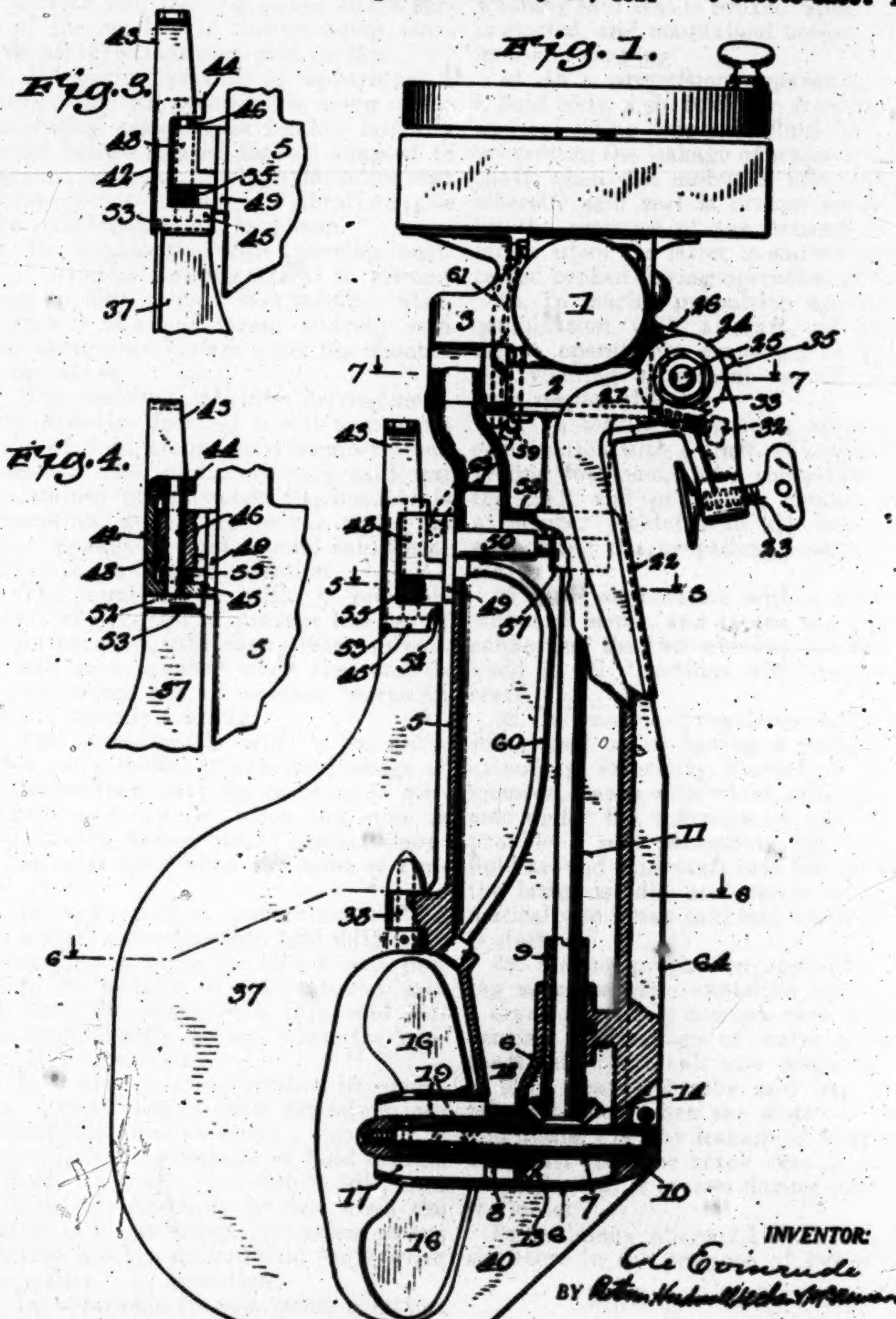
502

Feb. 3, 1925. 1,524,857

O. EVINRUDE

MOTOR PROPELLER

Original Filed May 19, 1921 3 Sheets-Sheet 1



INVENTOR:

Ole Evinrude

BY

ATTORNEYS.

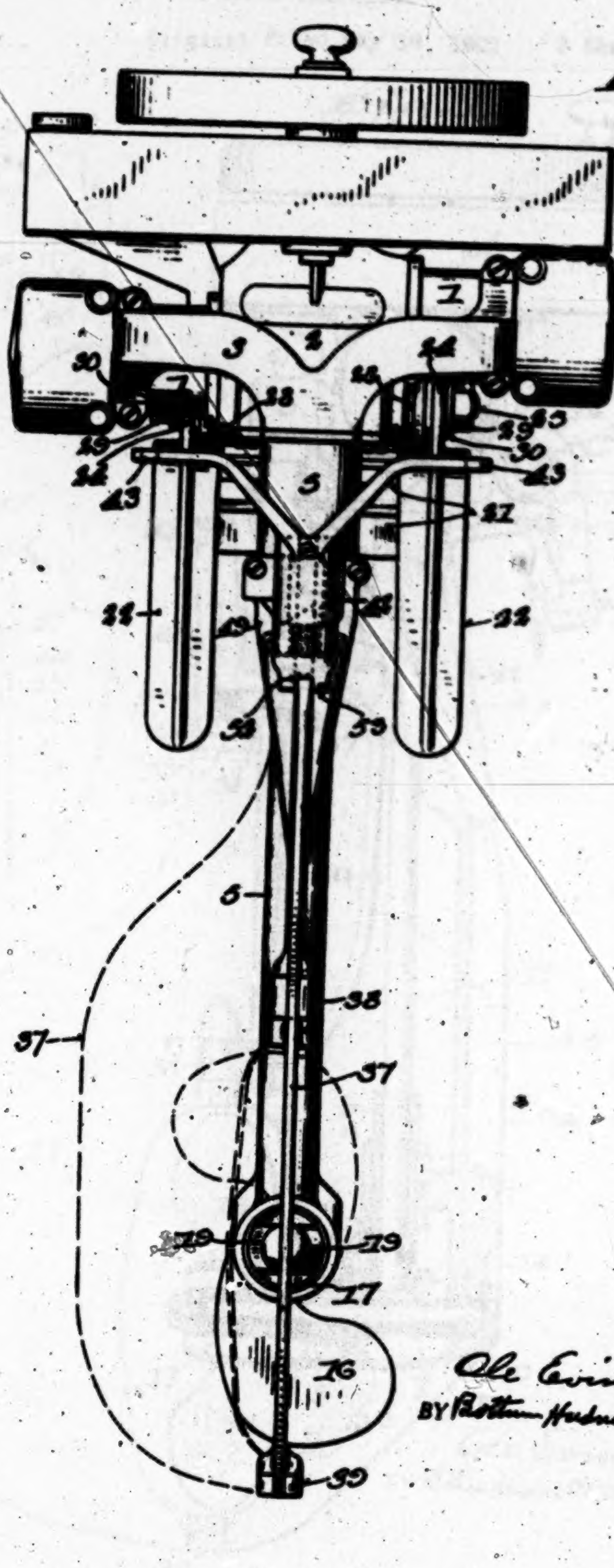
504 Feb. 3, 1925. 1,524,857

O. EVINRUDE

MOTOR PROPELLER

Original Filed May 19, 1921 3 Sheets-Sheet 2

Fig. 2.



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Feb. 3, 1925. 1,524,857

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MOTOR PROPELLER

Original Filed May 19, 1921 3 Sheets-Sheet 3

Fig. 5.

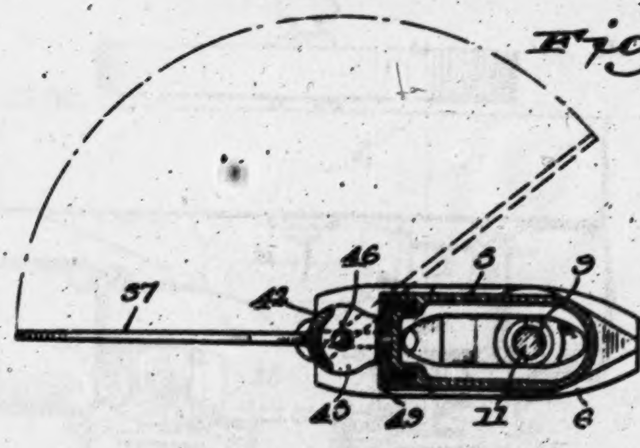


Fig. 6.

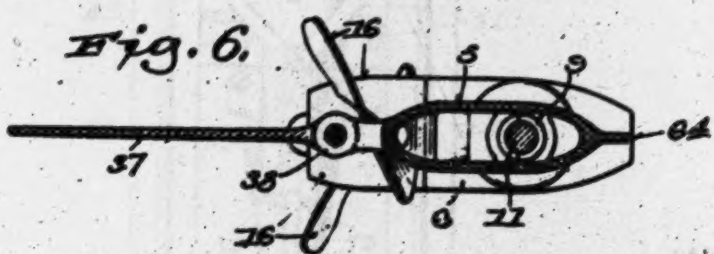


Fig. 7.

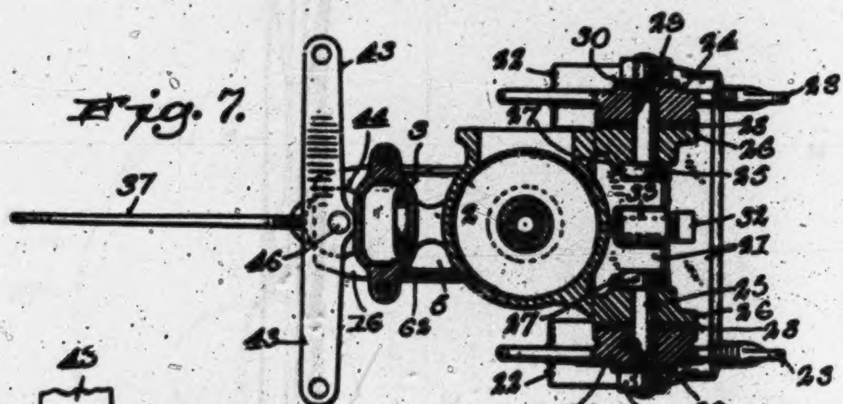
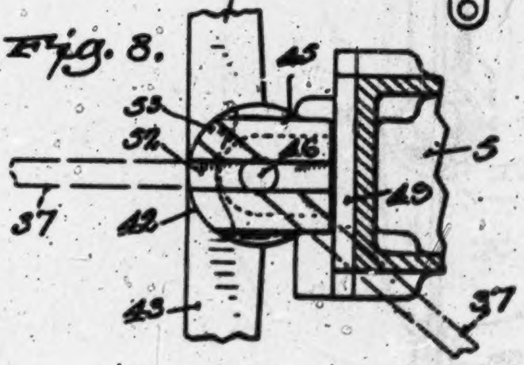


Fig. 8.



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Patented Feb. 3, 1925. 507 **1,524,857**

UNITED STATES PATENT OFFICE.

OLE EVINRUDE, OF MILWAUKEE, WISCONSIN.

MOTOR PROPELLER.

Application filed May 19, 1921, Serial No. 470,898. Renewed September 15, 1924.

To all whom it may concern:

Be it known that I, OLE EVINRUDE, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Motor Propellers, of which the following is a specification, reference being had to the accompanying drawing, forming a part thereof.

This invention relates more particularly to outboard motor propellers comprising internal combustion engines for use on boats of various kinds, particularly small or light craft such as row boats, canoes, etc.

Its main objects are to utilize the propeller post for conducting and discharging the exhaust from the motor or engine below the surface of the water, and incidentally for housing the transmission connections between the engine and propeller wheel; to provide for locking the rudder swung forward against or close to one side of the propeller post for convenience in transporting the motor propeller as a unit when detached from a boat; to provide an adjustable yielding hinge or pivot connection between the motor propeller and a boat on which it is mounted, which will permit the propeller to swing rearwardly and upwardly and clear obstructions which it may encounter and which would or might otherwise break or injure it and its supporting and driving connections; and generally to improve the construction and operation of motor propellers of the type to which the invention relates.

It consists in the construction, arrangement and combination of parts as hereinafter particularly described and pointed out in the claims.

In the accompanying drawing like characters designate the same parts in the several figures.

Figure 1 is a side elevation partly in vertical medial section in a fore and aft plane, of a motor propeller embodying the invention; Fig. 2 is a rear elevation of the same; Fig. 3 is a side elevation of the steering and rudder locking head in connection with associated parts, showing the rudder swung forward against or close to the propeller post and locked in that position; Fig. 4 is a similar view showing the steering head in section and raised out of engagement with the rudder; Figs. 5, 6 and 7 are horizontal sections on the lines 5—5, 6—6 and 7—7 respectively, Fig. 1; and Fig. 8 is an enlarged inverted plan view of the steering head and associated parts.

Referring particularly to Figs. 1 and 2, a typical internal combustion engine, in the present case comprising two oppositely and horizontally disposed cylinders 1 and an intermediate crank case 2, is shown. An exhaust manifold, pipe or conduit 3 is bolted to the rear side of the cylinders 1 in communication with the exhaust ports thereof.

A hollow propeller supporting post, muffler and transmission housing 5, bolted or attached at the upper end to the crank case 2 and exhaust conduit 3 of the engine, is provided adjacent its lower end with a gear case 6 and with bearings 7, 8 and 9, for a propeller shaft 10 and transmission shaft 11. The shafts 10 and 11 are connected by bevel gears 13 and 14, enclosed in the case 6, and at its upper end the shaft 11 is connected with the crank shaft of the engine in the usual or any suitable manner (not shown).

A propeller wheel 16, mounted on the rear end of the shaft 10 has its hub formed with an annular exhaust passage 17, concentric therewith and registering at its front end with an exhaust outlet opening 18 in the rear side of the post 5. The passage 17 is contracted adjacent its rear end to prevent the spreading of the exhaust gases discharged therefrom and their interfering with the proper operation of the propeller blades, and it is provided with oblique or inclined vanes 19, adapted when the propeller wheel is rotated, to draw water and gases from the hollow post and muffler 5 and forcibly discharge the same from the rear end of the hub, and thus assist in the propulsion of the boat on which the motor propeller is mounted.

A bracket 21, comprising clamps 22, which are provided with thumb screws 23 for detachably fastening it on the back, a gunwale or other part of a boat, is formed or provided with transversely aligned frictional pivot ears 24, which are connected by bolts 25, as shown in Figs. 1 and 7, with corresponding frictional pivot ears 26, formed or provided on the crank case 2 of the engine, so as to permit the propeller wheel with the supporting post 5 and the engine from which it is suspended, to be swung

rearwardly and upwardly for beaching the boat, clearing obstructions or traversing shallow water. The bolts 25 are held against turning in the bracket 21 by engagement of the bolt heads with lugs 27 on the ears 24, as shown in Fig. 7.

Between the ears 24 and 26, friction washers 28 of fiber or other suitable material, are interposed, and the pivot bolts 25 are threaded and provided with nuts 29 for varying the frictional engagement of the ears with each other or the washers 28 between them, so as to hold the motor propeller in proper working position under normal conditions and at the same time to allow the lower end of the post 5 with the propeller wheel to yieldingly swing rearward and upward to clear obstructions which would or might otherwise break or injure the apparatus.

Between the nuts 29 and the ears 24, washers 30 are interposed and loosely keyed on the threaded ends of the bolts, as shown in Fig. 7, to prevent the loosening of the nuts by the swinging of the motor propeller on its pivot connections with the bracket 21.

An adjustable stop screw 32, threaded in a lug 33 on the bracket 21, by engagement with the crank case 2 or an associated part of the engine, limits the forward swing of the motor propeller on its pivot connections with the bracket 21, affords means for adjusting the post 5 to a vertical position according to the inclination of the part of the boat on which the clamp 21 is mounted, and resists the forward thrust of the propeller wheel against the lower end of the post.

Lugs 35, on the pivot ears 26, by engagement with a cross piece of the bracket 21, limit the rearward and upward swing of the motor propeller on its pivot connections with the bracket.

A rudder 37 is pivoted to vertically aligned lugs 38 and 39 on the rear side of the post 5 and the lower end of a guard 40 extending from the lower end of the post below the propeller wheel. A vertically shiftable tiller or steering head 42, provided with cross arms 43 for the attachment of steering ropes, chains or wires, is pivotally mounted on the rear side of the post 5 above and in alignment with the pivot connections of the rudder with the post.

As shown in Figs. 1, 3, 4 and 8, the head 42 is formed with ears 44 and 45, in which a vertical pivot pin 46 is secured. The pin 46 is fitted to turn and slide lengthwise in a lug or sleeve 48, which may be conveniently formed on a flange or plate 49 of a pump barrel or cylinder 50, and bolted or fastened therewith to the post 5. The ear 45 or the lower end of the head 42, is angular or has a straight edge on the front side, in a vertical plane parallel with the tiller arms 43, as shown in Fig. 8, and is formed with grooves 52 and 53 of different depths intersecting each other in alignment with the pivot pin 46, and adapted to engage with the upper end of the rudder, as shown in Figs. 1, 2 and 3.

A spring 55, interposed between the lug 48 and the ear 45, yieldingly holds the head 42 with either of its grooves 52 or 53 in engagement with the rudder, as shown in Figs. 1 and 3, and permits the head to be drawn upwardly out of engagement with the rudder, as shown in Fig. 4, to permit swinging the rudder from operative to inoperative position, or vice versa.

The shaft 11 is provided with a cam 57, which engages with and operates the pump plunger 58 for circulating cooling water through the cylinder jackets of the engine. A suction pipe 60, leading upwardly from an opening in the rear side of the post 5 through the muffler chamber, supplies water to the pump.

The discharge of the pump is connected in the usual or any suitable manner with the cylinder jackets, for instance by a branching pipe 59, and the spent cooling water is discharged from the upper parts of the jackets, for instance by pipes 61, as indicated by dotted lines in Fig. 1.

A deflector 62, is provided in the exhaust inlet to the muffler chamber in the post 5 above the pump barrel 50, to prevent the direct impact of the exhaust gases against, and the overheating of, the pump.

The post 5 is extended in a fore and aft direction to resist the strains to which it is subjected, and to afford a muffler chamber of sufficient capacity, and is preferably formed on the front side with a central vertical strengthening rib or fin 64, which with the wheel guard 40 below the post, and the oblong shape of the post, as shown in Fig. 6, in front of the propeller wheel, smoothly cleaves the water without interfering with the effective operation of the wheel.

In the operation of the motor propeller, when the engine is started and the propeller wheel is rotated, water which has entered and risen in the muffler chamber, is immediately drawn and expelled therefrom through the passage 17 in the wheel hub by the action of the vanes 19, which then operate to expel the exhaust gases discharged into the muffler chamber from the engine, to relieve the engine of back pressure and to assist in the propulsion of the boat.

For running in shallow water and for beaching the boat, the post 5 with the propeller wheel may be swung rearwardly and upwardly on the pivot bolts 25, with or without slackening the nuts 29.

In case an obstruction is encountered by the post 5 or wheel guard 40, which would

or might break or injure the apparatus, the post with the propeller wheel will yieldingly swing rearward and upward on its adjustable friction pivot connections with the bracket 21 and clear the obstruction.

For convenience in transporting or carrying the motor propeller when it is removed with the bracket 21 from a boat, the rudder 37 is disengaged from the deep groove 52 in the head 42 by lifting the head, as shown in Fig. 4, and then swinging it forward against or close to the post, as indicated by dotted lines in Figs. 2, 5 and 8, in which position it is locked and held by engagement with the shallow groove 53 and by the engagement of the angular ear 45 with the flange or plate 49, as shown in Fig. 3.

Various modifications in the construction and arrangement of parts of the apparatus may be made without departure from the principle and scope of the invention as defined in the following claims.

I claim:

1. In a motor propeller the combination with an internal combustion engine, of a propeller wheel suspended therefrom and having an exhaust passage extending through its hub adjacent its axis, and a conduit connected with the exhaust of the engine and having an opening registering with the passage in the propeller hub.

2. In a motor propeller the combination with an internal combustion engine, of a hollow post attached at its upper end to the engine in communication with the exhaust of the engine, and provided adjacent its lower end with an exhaust opening, a propeller shaft mounted in the lower end of the post and projecting rearwardly therefrom, a propeller wheel fixed on said shaft and having an exhaust passage extending through its hub and registering with the exhaust opening in the post, and a transmission shaft geared at its lower end with the propeller shaft and connected at its upper end with the engine.

3. In a motor-propeller the combination with an internal combustion engine of a propeller wheel having an annular exhaust passage extendng through its hub and a conduit connecting said passage connected with the exhaust port of the engine.

4. In a motor-propeller the combination with an internal combustion engine of a propeller wheel having an annular exhaust passage extending longitudinally through its hub concentrically with its axis and connected at its front end with the exhaust conduit of the engine, said passage being provided obliquely to the axis of the propeller wheel with a vane adapted with the rotation of the wheel to force the exhaust gases from the engine rearwardly through the wheel hub.

5. In a motor-propeller the combination with an internal combustion engine of a propeller wheel suspended therefrom and operatively connected therewith, the hub of the wheel having a co-axial annular exhaust passage extending longitudinally through it and connected at its front end with the exhaust conduit of the engine, said passage having an obliquely disposed vane for inducing a rearward flow therein when the wheel is rotated and being contracted towards its rear end.

6. In a motor-propeller the combination with an internal combustion engine, of a hollow post attached to and depending from the engine in communcation at its upper end with the exhaust port of the engine and provided adjacent its lower end with a rearwardly directed exhaust outlet opening, a propeller shaft carried by the lower end of the post, a propeller wheel mounted on said shaft and having an exhaust passage extending longitudinally through its hub and communicating at its front end with the outlet opening in the post adjacent the propeller shaft, and transmission gearing connecting the propeller shaft with the engine.

7. In a motor-propeller the combination of a propeller supporting post, a rudder pivoted to the rear side of the post, and a vertically shiftable steering and locking head pivotally connected with the post in alignment with the pivot axis of the rudder and provided in its lower end with intersecting grooves of different depths for engagement with the upper end of the rudder, said head having a part adapted in an elevated position to engage with a part on the post to hold the head and rudder against turning when the rudder is swung forward close to the post and engaged with the shallow groove.

8. In a motor-propeller the combination of a propeller supporting post, a rudder pivoted to the rear side of the post, a vertically shiftable steering and locking head pivotally connected with the post in alignment with the pivot axis of the rudder and having an angular lower end formed with intersecting grooves of different depths for engagement with the upper end of the rudder, a spring tending to shift the head downward, and a projection on the post with which the angular end of the head engages to prevent its turning when the rudder is swung forward and engaged with the shallower groove.

In witness whereof I hereto affix my signature.

OLE EVINRUDE.

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Nov. 3, 1925. **1,559,616**

L. J. JOHNSON ET AL

OUTBOARD MOTOR

Filed June 16, 1924

Fig. 1.

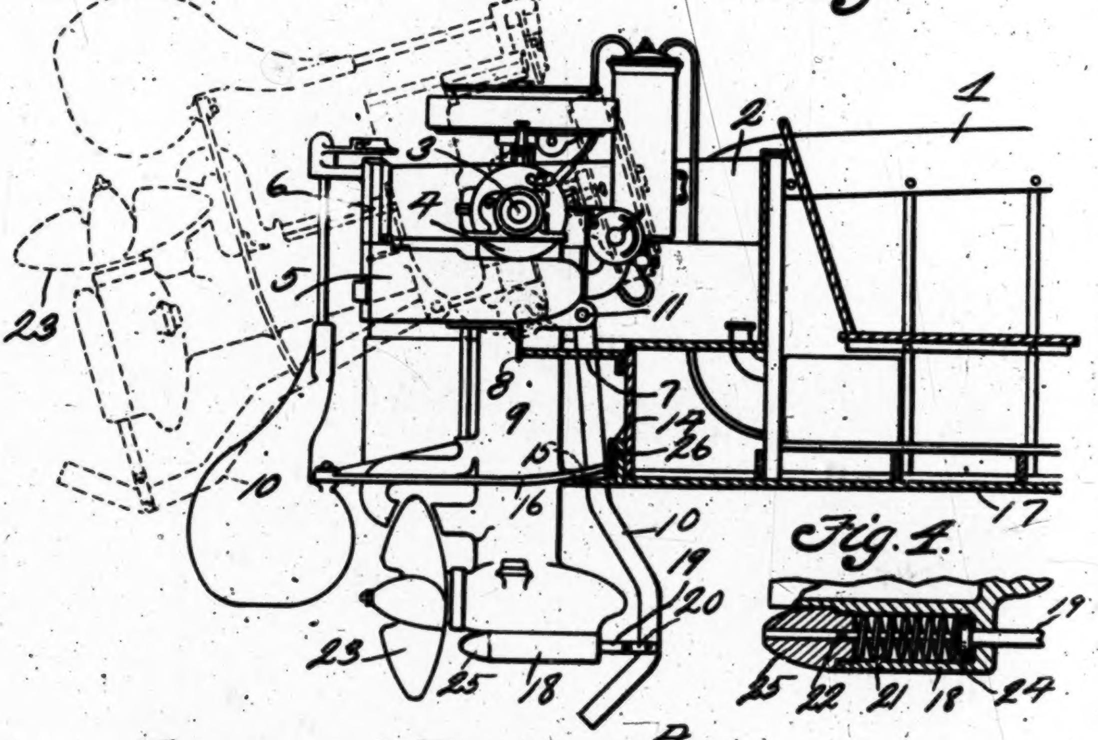
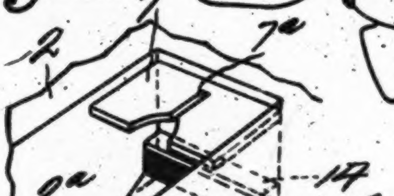


Fig. 4.

Fig. 2.

Fig. 3.



INVENTORS.

Louis J. Johnson.

Harry L. Johnson.

BY *George J. Oltsch*

ATTORNEY.

Patented Nov. 3, 1925. **1,559,616**

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UNITED STATES PATENT OFFICE.

LOUIS J. JOHNSON, OF MISHAWAKA, AND HARRY L. JOHNSON, OF INDIANAPOLIS, INDIANA, ASSIGNORS TO JOHNSON BROS. ENGINEERING CORPORATION, OF SOUTH BEND, INDIANA.

OUTBOARD MOTOR.

Application filed June 16, 1924. Serial No. 720,318.

To all whom it may concern:

Be it known that we, LOUIS J. JOHNSON, a citizen of the United States, residing at Mishawaka, in the county of St. Joseph and State of Indiana, and HARRY L. JOHNSON, a citizen of the United States, residing at Indianapolis, in the county of Marion and State of Indiana, have invented certain new and useful Improvements in Outboard Motors, of which the following is a specification.

The invention relates to outboard motors particularly of the type used in connection with small craft wherein the motor is pivotally mounted and movable, and has for its object to provide in connection with a motor of this character, means whereby when the motor comes into engagement with an obstruction, for instance a log, rock or sand bar, the initial shock of the impact will be yieldably taken up and absorbed, thereby reducing the strain on the motor.

A further object is to provide a pivoted outboard motor with a pivoted obstruction engaging arm extending downwardly forwardly of the free end of the casing and having its end yieldably connected to the casing and forming means for taking up the initial shock when coming into engagement with an obstruction, and relieving the strain on the motor, incident to the starting of the tilting operation thereof. The device is particularly adapted for use in connection with motors of the type set forth in our application for patent filed the 16th day of June, 1924, Serial No. 720,317.

A further object is to provide means whereby the pivoted arm will form a yieldable stop when the motor moves from a tilted to a vertical operative position, thereby reducing the strain on the motor incident to shock of a sudden stopping thereof in its pivotal movement.

With the above and other objects in view the invention resides in the combination and arrangement of parts as hereinafter set forth, shown in the drawing, described and claimed, it being understood that changes in the precise embodiment of the invention may be made within the scope of what is claimed without departing from the spirit of the invention.

In the drawings:—

Figure 1 is a vertical longitudinal sectional view through the stern of a boat, showing the motor carried thereby and in operative position.

Figure 2 is a view similar to Figure 1, showing the lower end of the pivoted motor as it approaches the operative position and the pivoted shock absorbing arm starting its shock absorbing operation.

Figure 3 is a detail perspective view of the lower portion of a recess in the stern of the boat, showing slotted members carried thereby for the reception of the shock absorbing arm.

Figure 4 is an enlarged detail sectional view through the lower end of the propeller drive shaft casing, showing the yieldable spring means.

Referring to the drawing, the numeral 1 designates the hull of a boat and 2 a recess in the stern thereof. Pivotally mounted at 3 within the upper end of the recess 2 is a motor 4 of a general outboard type, as set forth in the application above referred to, and wherein the muffler 5, and the transverse plate 6 forms a closure for the rear end of the recess 2, and a horizontal disposed bifurcated plate 7, in combination with a yieldable member 8 carried by the muffler at opposite sides of the drive shaft casing 9 forms a bottom closure for the recess. It has been found in outboard motors, and particularly motors of the character set forth, when the lower end of the motor engages a log or obstruction in the water, the initial shock and jar on the motor, incident to the impact, damages the motor and strains various parts thereof. To obviate this difficulty a yieldable guard arm 10 is provided, which arm is pivotally connected at 11 to the pivotally mounted motor and extends downwardly forwardly of the motor casing 9. The guard arm 10 extends through the slot 7ᵃ in the bifurcated plate 7, and the slot 12 in the lower flange 13 of the channeled member 14, and also through a slot 15 in the closure plate 16 carried by the casing 9, and which closure plate, when the motor is in operative position as shown in Figure 1 is in substantially the same plane as the bottom 17 of the boat. Arm 10 extends

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downwardly and forwardly, and thence downwardly and rearwardly to the forward side of the lower end 18 of the drive shaft casing, therefore it will be seen that when the boat runs into shoal water, for instance over a sand bar or hits a log or rock, the arm 10 will be forced rearwardly, at which time the piston rod 19, which has a link connection 20 with the arm 10, will be forced rearwardly, thereby compressing the coiled spring 21, surrounding the reduced guide portion 22 of the piston rod, consequently the initial shock of the impact is taken up and absorbed at the starting of the tilting operation to the dotted line position shown in Figure 1, consequently the propeller 23 will not come into contact with the obstructions. The reduced portion 22 of the piston rod is connected to the piston 24 which engages one end of the coiled spring 21 and it is slidably mounted in a movable plug 25, therefore it will be positively guided in its axial movement and will not bind. The link connection 20 allows freedom of movement during the shock absorbing operations.

After a tilting operation of the motor by engagement of the arm 10 with an obstruction, the motor will automatically move to vertical operative position after passing the obstruction, and which movement is a relatively quick one under the influence of the propeller 23, which rotates at all times, therefore it will be seen that considerable shock would take place on the motor if means were not provided for taking up the shock. Under the above conditions the arm 10, as the lower end of the motor approaches operative position passes into the slot 12 of the flange 13 as clearly shown in Figures 2 and 3 and the arm is stopped by engagement with the inner end of the slot 12, therefore the continued forward movement of the free end of the motor will compress the spring 21, thereby taking up the shock, and obviating sudden stopping of the free end of the motor. As the free end of the motor continues in its movement to operative position, the forward end of the plate 16 comes into engagement with a strip of yieldable material, for instance rubber, disposed in the channel 14, said yieldable material being designated by the numeral 26, consequently the shock of stopping is additionally checked and at the same time a relatively tight joint is provided when the plate 16 forms a relatively tight closure for the lower end of the reduced portion 2ª of the recess 2 in the stern of the boat.

From the above it will be seen that a yieldable obstruction engaging device is provided for outboard motors of the pivotally mounted type, and which obstruction engaging device will absorb the shock incident to the motor coming in contact with obstructions and will also absorb the shock incident to the motor returning to normal operative position, and one which is particularly adapted for use in connection with a pivoted motor mounted in a recess in the stern of a boat and extending through and carrying closure plates for the recess.

The invention having been set forth what is claimed as new and useful is:—

1. The combination with a pivotally mounted motor, said motor being carried by a boat, of a guard for the free end of said motor, said guard being yieldably mounted on the motor and yieldable in relation thereto and forming means whereby initial shocks will be taken up.

2. The combination with a pivotally mounted outboard motor, a propeller carried by the free end of said motor, said motor being pivotally connected to a boat, of a yieldable shock absorbing obstacle engaging member carried by the free end of the motor and yieldable in relation to the motor.

3. The combination with a pivotally mounted outboard motor, a propeller carried by the free end of said motor, of a yieldable shock absorbing obstacle engaging member carried by the free end of the motor forwardly of the propeller and yieldable in relation to the motor.

4. The combination with a pivotally mounted outboard motor, a propeller carried by the free end of said motor, an arm pivotally connected to the motor and extending towards its free end forwardly of the propeller, and a yieldable connection between the arm and the free end of the motor.

5. The combination with a pivotally mounted outboard motor, a propeller carried by the free end of said motor, an arm pivotally connected to the motor at its forward side and terminating forwardly of the free end of the motor and forwardly of the propeller, and a yieldable connection between the arm and the motor.

6. The combination with the free end of a pivotally mounted outboard motor, a propeller carried by said free end, of an obstacle engaging and shock absorbing member carried by said free end of the propeller, said member comprising an arm pivoted to the motor, said arm extending downwardly forwardly of the propeller, a coiled spring disposed in a chamber of the free end of the motor, and means carried by said arm and cooperating with the spring whereby initial shocks of impacts will be taken up by the spring and relieved from the motor.

7. The combination with a pivotally mounted outboard motor carried by a boat, of a yieldably mounted propeller guard,

said guard forming means whereby shocks of impacts will be taken up as the motor is moved from operative to inoperative position, and from inoperative to operative position.

8. The combination with a pivotally mounted motor, said motor being pivotally connected to a boat, of a shock absorbing arm pivoted to the motor and disposed between the motor and the boat, said shock absorbing arm forming a guard for the free end of the motor, and a yieldable buffer between the motor and the boat.

9. The combination with a pivotally mounted motor, said motor being pivotally mounted in a recess in a boat, plates disposed within the recess and carried by the motor and forming closures for said recess, of a pivoted guard arm carried by the motor and extending downwardly through slots in the plates to a position adjacent the free end of the motor, yieldable connections between the arm and the motor, said arm forming a shock absorber upon initial upward movement of the motor and upon final downward movement of the motor.

10. The combination with a pivotally mounted motor, said motor being pivotally mounted on a boat, of a pivoted yieldably connected guard arm interposed between the motor and the boat and forming shock absorbing means upon initial upward movement of the motor and upon final downward movement of the motor.

In testimony whereof we affix our signatures.

LOUIS J. JOHNSON.
HARRY L. JOHNSON.

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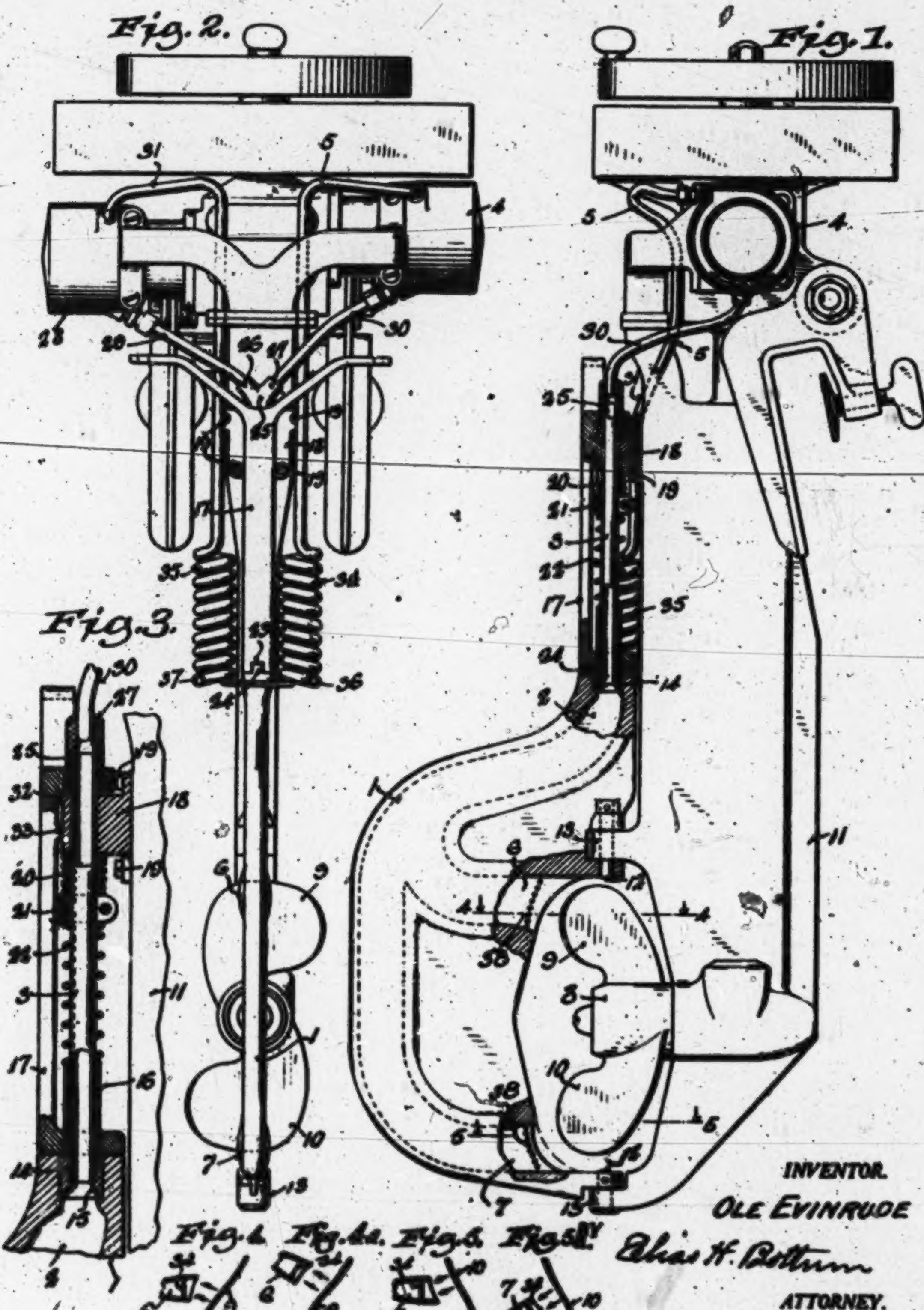
Dec. 29, 1925 1,567,127

O. EVINRŪDE

WATER-COOLING SYSTEM FOR OUTBOARD MOTORS

Filed June 28, 1924



INVENTOR.

OLE EVINRUDE

BY Elias H. Bottum

ATTORNEY.

Patented Dec. 29, 1925. 1,567,127

UNITED STATES PATENT OFFICE.

OLE EVINRUDE, OF MILWAUKEE, WISCONSIN, ASSIGNOR TO ELTO OUTBOARD MOTOR CO., OF MILWAUKEE, WISCONSIN, A CORPORATION OF WISCONSIN.

WATER-COOLING SYSTEM FOR OUTBOARD MOTORS.

Application filed June 23, 1924. Serial No. 722,335.

To all whom it may concern:

Be it known that I, OLE EVINRUDE, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Water-Cooling Systems for Outboard Motors, of which the following is a specification, reference being had to the accompanying drawing, forming a part thereof.

This invention relates to a water cooling system for outboard motors.

It relates particularly to a water cooling system in which circulation of the water through the water jackets of the cylinders is effected by the action of the propeller.

An object of the invention is to provide an improved water cooling system for outboard motors in which there is no mechanical wear and no valves.

Another object is to provide an improved water cooling system for outboard motors in which the rudder is part of the system and is pivotally connected to the transmission housing, the pivotal connection also being part of the system.

Another object is to provide an improved water cooling system for outboard motors which operates efficiently in sandy, muddy or salt water.

Another object is to provide an improved water cooling system for outboard motors which is self-draining.

Another object is to provide an improved water cooling system for outboard motors which operates efficiently when the motor is running at low speed.

Another object is to provide an improved water cooling system for outboard motors which operates efficiently when the rudder is turned in either direction, in making a turn.

Another object is to provide an improved water cooling system for outboard motors which is simple, efficient, and which may be economically manufactured.

Other objects and advantages will hereinafter appear.

For the purpose of illustrating the invention, an embodiment thereof is shown in the drawings, in which

Figure 1 is a side elevation, partly in section, showing the manner in which the parts of the water cooling system are arranged and connected for cooperation together;

Fig. 2 is an end elevation, looking toward the right in Fig. 1;

Fig. 3 is an enlarged detail view, partly in section;

Figs. 4 and 4ᵃ are sections on line 4—4 of Fig. 1; and

Figs. 5 and 5ᵃ are sections on line 5—5 of Fig. 1.

The water cooling system comprises, in general, a rudder 1 provided with a passage 2, a tube 3, a water jacket 4, and an outlet connection 5 from the water jacket, the tube 3 providing a connection between passage 2 and water jacket 4.

The inlet end of passage 2 may comprise two inlet passages 6 and 7 which terminate adjacent to the propeller 8, so that the blades 9 and 10 thereof force water into the inlet passages 6 and 7 upwardly through passage 2 and tube 3 to water jacket 4.

The rudder 1 may be pivotally mounted to the transmission housing 11 by means of pins 12 which pass through lugs 13 cast integrally with the housing, and are positioned with their centers in line with the center of tube 3. The rudder may thereby be swung about pins 12 and tube 3.

The lower end of tube 3 fits snugly into a seat 14 pressed into rudder 1 at the outlet end of passage 2, and rests upon a shoulder 15 with which seat 14 is provided, as shown in Fig. 3.

A sleeve 16, slidable on tube 3, is pressed into the lower end of a tiller yoke 17 for movement therewith.

The upper end of tube 3 passes loosely through a suitable bracket 18 secured to housing 11 by bolts 19 or other suitable means.

A spring 20 is compressed between bracket 18 and a suitable clamp 21 fixed to tube 3. Spring 20 thereby acts upon clamp 21 to urge tube 3 downwardly at all times so that a close fit is always maintained between the lower end of the tube and shoulder 15 of seat 14, to prevent leakage of water at the seat.

A second spring 22 is arranged between clamp 21 and sleeve 16 to urge tiller yoke 17 downwardly to hold the same in interlocked engagement with rudder 3.

The lower end of tiller yoke 17 is provided with a recess 23 to interlock with a tongue 24 formed on the upper end of rudder 3 at the outlet end of passage 2.

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The upper end of tiller yoke 17 is pivotally mounted on the lower portion of a Y-connection 25 soldered or otherwise connected to the upper end of tube 3, so that the Y-connection is, in effect, a part of the tube.

The two branches 26 and 27 of Y-connection 25 are connected to the water jackets 28 and 4 of the cylinders by pipes 29 and 30, respectively.

The tiller yoke 17 and sleeve 16, fixed for movement therewith, may be slided vertically upon tube 3 and Y-connection 25 against the action of spring 22, until tongue 24 is out of interlocking engagement with recess 23. Rudder 1 may then be swung upon pins 12 and Y-connection 25 independently of tiller yoke 17, through an angle of about 180 degrees.

When the tiller yoke is then released, spring 22 returns it to its former position and locks the rudder in position alongside of housing 11. Rudder 1 may thereby be folded out of the way and locked in position to facilitate transportation of the motor.

This interlocking engagement of tiller yoke 17 with rudder 1, to permit folding of the rudder out of the way, is described and claimed in my Patent No. 1,524,857 of Feb. 3, 1925, and is only shown and described in this application with sufficient clearness to show the manner in which it may be embodied in connection with the improved water cooling system.

Spring 20 is stiffer than spring 22 and is compressed between bracket 18 and clamp 21 so that it occupies substantially the entire space between the bracket and clamp, as shown in Figs. 1 and 3. The downward force exerted upon clamp 21 by spring 20 is therefore greater than the upward force exerted on the clamp by spring 22, so that the lower end of tube 3 is always held in its position against shoulder 15 of seat 14. When tiller yoke 17 is raised vertically, spring 22 is compressed to some extent, but not enough to overcome the downward force of spring 20 upon clamp 21.

Connection 30 is connected to water jacket 4 at substantially a right angle to the wall of the cylinder, so that the water in passing upwardly through the connection will be divided into two streams as indicated by arrows in Fig. 1, and pass upwardly around the cylinder in both directions and thence out through connection 5. Connection 29 is connected to water jacket 28 in the same manner. A more even distribution of water around the cylinders is thereby effected.

An outlet connection 31, similar to connection 5, is provided for water jacket 28.

The entrance to inlet opening 6 is cut at an angle, as shown in Fig. 4, so that when the rudder is turned in a clockwise direction, the entrance to the inlet passage will be normal to the direction of flow of the water from blades 9 and 10, as indicated by arrows in Fig. 4^a.

The entrance to inlet opening 7 is cut at an angle, as shown in Fig. 5, so that when rudder 1 is turned in a counter-clockwise direction the entrance to the inlet opening 7 will be normal to the direction of flow of the water from blades 9 and 10, as indicated by arrows in Fig. 5^a.

In turning to port, as indicated in Fig. 4^a, the entrance to inlet opening 6 will be normal to the flow of water from blades 9 and 10, while the entrance to inlet opening 7 will not be. More water will then be forced through inlet opening 6, while less water will be forced through inlet opening 7.

In turning to starboard, as indicated in Fig. 5^a, the entrance to inlet opening 7 will be normal to the flow of water from blades 9 and 10, while the entrance to inlet opening 6 will not be. More water will then be forced into inlet opening 7, while less water will be forced through inlet opening 6.

The average amount of water entering both inlet passages 6 and 7, however, will be substantially the same in any position of the rudder.

A cooling system is thereby provided which is just as efficient in coming about as in proceeding ahead, by cutting the entrances to inlet passages 6 and 7 at angles to make either passage conform substantially to the pitch of the propeller blades when the rudder is in either extreme position.

Bracket 18 may be provided with a stop 32 arranged to engage with a lug 33 formed integrally with tiller yoke 17, as shown in Fig. 3, to prevent vertical movement of the tiller yoke to a position where the upper end thereof will engage branches 26 and 27 of Y-connection 25 and lift the lower end of tube 3 from its proper position in seat 14.

The outlet connections 5 and 31 extend downwardly and terminate in coils 34 and 35, respectively. The coils 34 and 35 are arranged so that the outlet ends 36 and 37 thereof are positioned a short distance above the level of the water, and are not submerged.

Rods 38 may be arranged in parallel relation across the entrances to inlet passages 6 and 7, as shown in Figs. 1, 4 and 5, to prevent solid matter from entering the passages.

The rudder 1 may be cast from any suitable metal such as aluminum and the passages 2, 6 and 7 cored therein.

The operation of the water cooling system is as follows:

The action of propeller blades 9 and 10 forces water into inlet passages 6 and 7 upwardly through passage 2, tube 3, connections 29 and 30 to water jackets 4 and 28, and thence through outlet connections 5 and 31 and coils 34 and 35.

The weight and velocity of the water in coils 34 and 35 tend to maintain the flow of water through the system, so that a comparatively slight rotation of the propeller is sufficient to cause the water to circulate.

A water cooling system is thereby provided which operates efficiently when the motor is running at low speed, by providing the coils 34 and 35 at the lower ends of outlet pipes 5 and 31.

By providing the rudder with inlet passages 6 and 7 having their inlet openings arranged adjacent to the propeller blades and leading toward a common passage 2, more even circulation of water is effected.

There are no valves to wear and decrease the efficiency of the system, the only wear being at the end of tube 3. Any wear at the end of tube 3 caused by the movement of seat 14 is compensated for by spring 20, which holds the lower end of the tube in close engagement with the seat, as explained more fully above. The efficiency of the water cooling system is therefore in no way affected by the action of sandy, muddy or salt water.

When the motor stops the water drains from water jackets 4 and 28 through connections 29 and 30 and tube 3. The water also drains freely from outlet connections 5 and 31 and coils 34 and 35. The water cooling system is thereby self-draining, so that there is no danger of water freezing in the jackets or connections.

Various changes of structure and arrangement of the parts may be adopted without departing from the spirit of the invention or the scope of the claims.

The invention claimed is:

1. In a water cooling system for outboard motors, in combination, a housing, a propeller supported at the lower end of said housing, said rudder being provided with a passage having the inlet end thereof arranged adjacent to said propeller, a water jacket supported by said housing, a tube connecting said water jacket with the outlet end of said passage, and an outlet connection leading from said water jacket.

2. In a water cooling system for outboard motors, in combination, a housing, a propeller supported at the lower end of said housing, a rudder pivotally mounted to said housing, said rudder being provided with a passage having the inlet end thereof formed to comprise two inlet passages terminating adjacent to the blades of said propeller, a water jacket supported by said housing, a tube connecting said water jacket with the outlet end of said passage, and an outlet connection leading from said water jacket.

3. In a water cooling system for outboard motors, in combination, a housing, a propeller supported at the lower end of said housing, a rudder pivotally mounted to said housing, said rudder being provided with a passage having the inlet end thereof formed to comprise two inlet passages terminating adjacent to the blades of said propeller and cut at angles to make either conform substantially to the pitch of said blades when said rudder is in either extreme position, a water jacket supported by said housing, a tube connecting said water jacket with the outlet end of said passage, and an outlet connection leading from said water jacket.

4. In a water cooling system for outboard motors, in combination, a housing, a propeller supported at the lower end of said housing, a rudder pivotally mounted to said housing, said rudder being provided with a passage having the inlet end thereof arranged adjacent to said propeller, a water jacket supported by said housing, and a tube supported by said housing and arranged to connect said water jacket with the outlet end of said passage, said tube providing a pivotal connection for said rudder to said housing.

5. In a water cooling system for outboard motors, in combination, a housing, a propeller supported at the lower end of said housing, a rudder pivotally mounted to said housing, said rudder being provided with a passage having the inlet end thereof arranged adjacent to said propeller, a water jacket supported by said housing, a tube connecting said water jacket with the outlet end of said passage, the outlet end of said passage being provided with a seat, the lower end of said tube being fitted to said seat, and a spring arranged to hold the lower end of said tube in operative position in said seat.

6. In a water cooling system for outboard motors, in combination, a housing, a propeller supported at the lower end of said housing, a rudder pivotally mounted to said housing, said rudder being provided with a passage having the inlet end thereof arranged adjacent to said propeller, a water jacket supported by said housing, a tube supported by said housing and arranged to connect said water jacket with the outlet end of said passage, said tube providing a pivotal connection for said rudder to said housing, and a spring arranged on said tube to hold the lower end thereof in operative engagement with the outlet end of said passage.

7. In a water cooling system for outboard motors, in combination, a housing, a propeller supported at the lower end of said housing, a rudder pivotally mounted to said housing, said rudder being provided with a passage having the inlet end thereof arranged adjacent to said propeller, a water jacket supported by said housing, a tube connecting said water jacket with the outlet end of said passage, the outlet end of said passage being provided with a seat, the lower

end of said tube being fitted to said seat, a spring arranged to hold the lower end of said tube in operative position in said seat, a tiller yoke supported for movement with respect to said rudder and for interlocking engagement therewith, and a second spring arranged to hold said tiller yoke and said rudder in interlocking engagement.

8. In a water cooling system for outboard motors, in combination, a housing, a propeller supported at the lower end of said housing, a water jacket supported by said housing, connections arranged to provide a passage leading from a point adjacent said propeller to said water jacket, and an outlet connection leading from said water jacket, the outlet end of said outlet connection being provided with a coil.

9. In a water cooling system for outboard motors, in combination, a housing, a propeller supported at the lower end of said housing, a rudder pivotally mounted to said housing, said rudder being provided with a passage having the inlet end thereof arranged adjacent to said propeller, a water jacket supported by said housing, a tube connecting said water jacket with the outlet end of said passage, and an outlet connection leading from said water jacket, the outlet end of said outlet connection being provided with a coil arranged so that the outlet end thereof will be positioned above the level of the water when the motor is in use.

10. In a water cooling system for outboard motors, in combination, a housing, a propeller supported at the lower end of said housing, a rudder pivotally mounted to said housing, said rudder being provided with a passage having the inlet end thereof arranged adjacent to said propeller, a water jacket supported by said housing, and a tube supported by said housing and arranged to connect said water jacket with the outlet end of said passage, the outlet end of said outlet connection being provided with a coil arranged so that the outlet end thereof will be positioned above the level of the water when the motor is in use.

11. The combination with an outboard motor having a cooling jacket, a depending shaft and a propeller mounted thereon, of a rudder mounted to the rear of said propeller and provided with a passage connected to said cooling jacket at one end and arranged at its other end to receive a portion of the water forced rearwardly by said propeller.

12. The combination with the propeller and water jacket of a marine engine, of a rudder mounted to the rear of said propeller and provided with a passage communicating with said water jacket and arranged to receive a portion of the water forced rearwardly by said propeller.

13. The combination with an outboard motor provided with a water cooling jacket having inlet and outlet openings, means for conducting water from a point to the rear of the propeller into said jacket through said inlet opening, and a coiled pipe attached to said outlet opening for the discharge of water from said jacket, said coiled pipe acting to sustain the flow of water through said jacket for varying propeller speeds.

14. The combination with an outboard motor having a propeller and a water cooling system including a water jacket and a rudder provided with a passage arranged to receive water forced rearwardly by said propeller, of a rigid tube connecting said passage to said water jacket whereby water is caused to flow through the latter upon operation of said propeller.

15. The combination with an outboard motor having a propeller and a water cooling system including a water jacket and a rudder rotatably connected to said motor and provided with a passage arranged to receive water forced rearwardly by said propeller, of a tube connecting said passage to said water jacket whereby water is caused to flow through the latter upon operation of said propeller, the longitudinal axis of said tube being coincident with the axis of rotation of said rudder.

16. The combination with an outboard motor having a propeller and a water cooling system including a water jacket and a rudder pivotally connected to said motor and provided with a passage arranged to receive water forced rearwardly by said propeller, of a rigid tube connecting said passage to said water jacket whereby water is caused to flow through the latter upon operation of said propeller, said tube also acting to pivotally connect said rudder to said motor.

17. The combination with a water-jacketed marine engine having an intake pipe extending below the water line and adapted to receive water forced rearwardly by the propeller and to conduct the same upwardly into said water jacket, of an outlet conduit leading from said jacket and terminating above the water line and being so formed as to materially increase the distance of travel of the water in its flow from said jacket to the outlet end of said conduit to thus sustain the flow of said water over an increased range of propeller speeds.

18. The combination with a water-jacketed marine engine having an intake pipe extending below the water line and adapted to conduct water from the propeller upwardly into said water jacket, of an outlet connection leading from said jacket and means associated therewith tending to sustain the flow for varying propeller speeds, said means comprising a coil interposed in said outlet connection.

19. The combination with the water jacket of a marine engine, of a rudder having a passage formed therein and arranged to receive water upon forward movement of the boat, and means connecting said passage to said water jacket.

20. The combination with an outboard motor having a water jacket and a propeller, of a rudder supported adjacent to said propeller and having a passage formed therein, said passage being arranged to receive a portion of the water forced in one direction by said propeller, and means connecting said passage to said water jacket whereby said portion of the water is caused to flow through said water jacket.

21. The combination with an outboard motor having a water jacket and a propeller, of a rudder supported adjacent to said propeller and having a passage formed therein, said passage being arranged to receive a portion of the water forced in one direction by said propeller, and a rigid tube connecting said passage to said water jacket whereby said portion of the water is caused to flow through said water jacket.

In witness whereof I hereto affix my signature.

OLE EVINRUDE.

Certificate of Correction.

It is hereby certified that in Letters Patent No. 1,567,127, granted December 29, 1925, upon the application of Ole Evinrude, of Milwaukee, Wisconsin, for an improvement in "Water-Cooling Systems for Outboard Motors," an error appears in the printed specification requiring correction as follows: Page 3, lines 42 and 43, after the word "housing" insert the words *a rudder pivotally mounted to said housing;* and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 26th day of January, A. D. 1926.

[SEAL.]

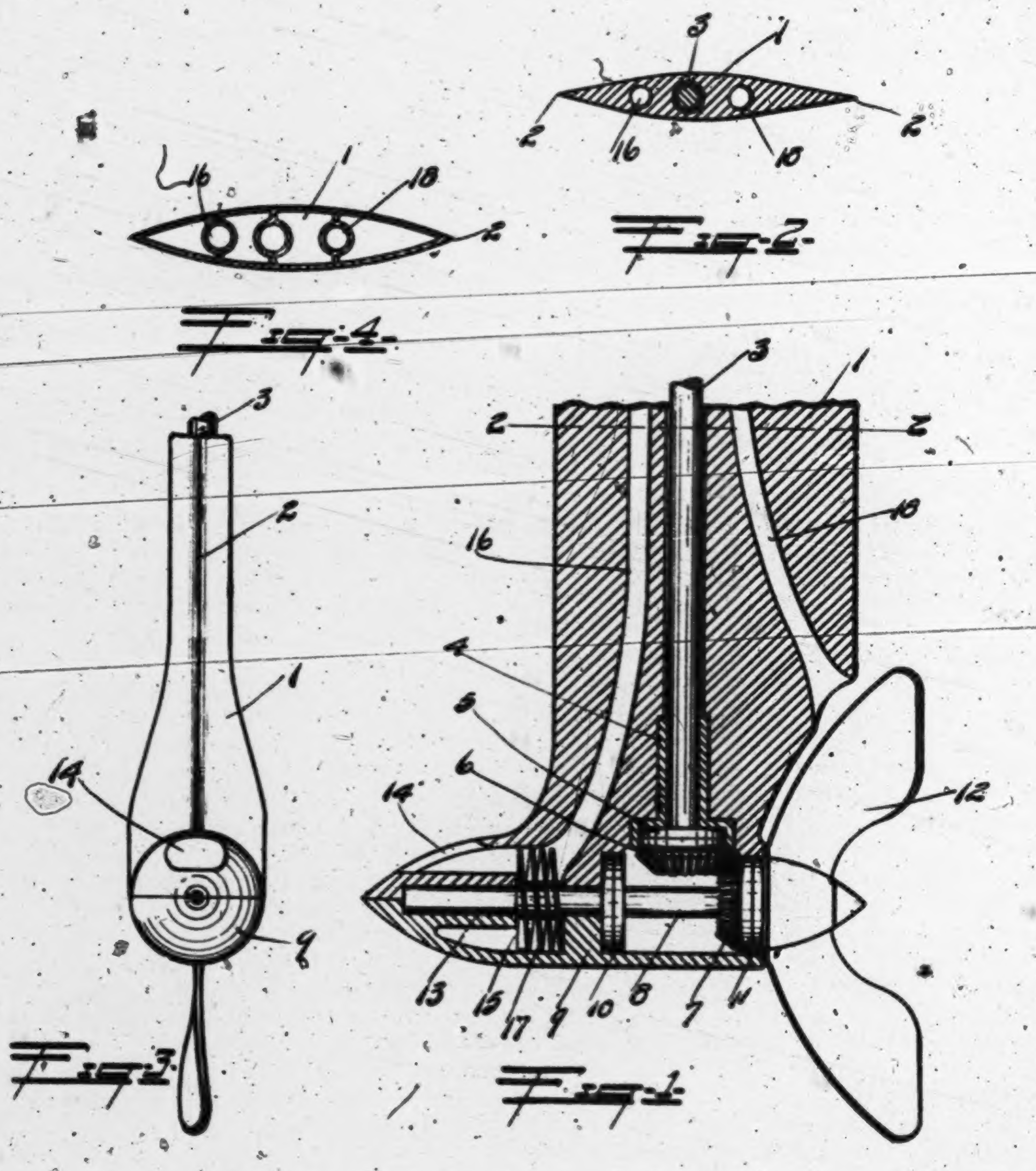
WM. A. KINNAN,
Acting Commissioner of Patents.

526
April 6, 1926. 1,579,834

J. H. PIERCE

MARINE PROPULSION DEVICE

Filed Oct. 10. 1924



INVENTOR.

James H. Pierce.

BY

Frank C. Larman,

ATTORNEY.

Patented Apr. 6, 1926. 527 1,579,834

UNITED STATES PATENT OFFICE.

JAMES H. PIERCE, OF BAY CITY, MICHIGAN.

MARINE PROPULSION DEVICE.

REISSUED

Application filed October 10, 1924. Serial No. 742,814.

To all whom it may concern:

Be it known that I, JAMES H. PIERCE, a citizen of the United States of America, and a resident of Bay City, in the county of Bay and State of Michigan, have invented new and useful Improvements in Marine Propulsion Devices, of which the following is a specification.

This invention relates to improvements in marine propulsion devices, and particularly to the submerged gear case and propeller shaft housing assembly of the conventional outboard motor.

One object of the invention is to design a propeller shaft housing and gear case assembly having new and novel means for forcing the water to the water jacket of the motor and whereby the usual pump is eliminated.

Another object is to design power and propeller shaft housings of simple and substantial design, and in which water intake and overflow passages are cored in or piped to the water jacket of the motor.

A further object is to design a gear casing to eliminate the possibility of sand or water getting into the gears or propeller shaft bearings.

The above and other objects will appear as the specification progresses, reference being had to the accompanying drawing in which I have shown the preferred embodiment of my invention, and in which like reference numerals indicate like parts throughout the several views thereof.

In the drawing.

Fig. 1 is a fragmentary vertical sectional view of a power shaft housing gear case and propeller shaft housing.

Fig. 2 is a section taken on the line 2—2 of Fig. 1.

Fig. 3 is a front view thereof.

Fig. 4 is also a sectional view similar to that shown in Fig. 2 showing an alternate form of construction.

It has always been somewhat troublesome in outboard motors to provide simple means for forcing water up to cool the cylinders of portable motors of this type, as it generally necessitates a force pump equipped with valves operated by a cam or other device, and these valves stick and grind due to the sand and foreign matter taken into the pump with the water, the pump is therefore short lived, expensive to build, and is subject to clogging, it also necessitates a bulky design which must be forced through the water, with the consequent loss of power, and these objectionable features I have overcome by eliminating the pump and providing a structure not affected by sand and foreign matter and which has no movable parts.

In my improved design I provide a vertically extending power shaft housing which can be cast of aluminum or other light metal, this is preferably wedge shaped as shown, the edges being thin and sharp to eliminate water resistance.

A power shaft 3 is rotatably mounted in this power shaft housing which is cored to receive it, and a bushing 4 is fitted to the lower end thereof which is cored to form a gear casing, a thrust bearing 5 being mounted in this bushing, and a bevel gear 6 is keyed on the lower end of the power shaft, meshing with and driving a bevel gear 7 mounted on a propeller shaft 8, which is journaled in a propeller shaft housing 9, this housing is cylindrical in shape, the top half being cast integral with the power shaft housing, the lower half being machined and fitted thereto, and is held in place by screws (not shown) in the usual manner. Bearings 10 and 11 are mounted in this housing, and the propeller shaft 8 is journaled thereon, the one end projecting beyond the housing and having a propeller member 12 fixed thereon, the front end of the shaft being journaled in a sleeve bearing 13 formed in the housing proper. It will also be obvious that the front end or nose of the housing can be formed separate and threaded to engage the main body, or it can be bolted thereto if desired, this is however merely a detail of construction.

An intake port or opening 14 is located in the end or nose of the propeller shaft housing, and leads to a chamber 15 through which the propeller shaft extends, said chamber communicating with an upwardly extending passage 16 formed in the power shaft housing. A spiral 17 formed of thin metal, is mounted on the propeller shaft 8 in this chamber 15, and as the water enters through said port, the spiral forces it up this passage and to the water jacket of the engine, (not shown).

A similar passage 18 is formed on the opposite side of the power shaft for accommodating the overflow or discharge, and opens directly adjacent the propeller and

below the water line, locating the overflow at this point also has its advantages, as the displacement of water by the propeller sets up a partial vacuum to accelerate the circulation or flow of the water in the water jacket, further, when reversing with a motor where a conventional pump is used, the supply is either entirely cut off, or reduced to such extent as to be entirely insufficient. In my improved construction a full supply is assured regardless of the direction of rotation of the motor, as the reversing thereof merely reverses the direction of flow of water to the water jacket, the propeller forcing it into the passage 18, the spiral 17 forcing it out of the intake port above described.

In Fig. 4 of the drawing I have shown an alternate form of construction, the power shaft housing being pressed, with tubes of brass or copper secured therein for the propeller shaft and water passages, this makes a very light and economical housing, the principle being identically similar to that above described. It will also be obvious that a screen should be placed over the intake port to exclude chips, weeds and foreign matter.

From the foregoing description it will be obvious that I have perfected a very simple, substantial and economical marine propulsion device which is very efficient in operation, and is composed of a minimum number of parts.

What I claim is:—

1. In a marine propulsion device provided with a vertically disposed knife edged wedge shaped power shaft housing, a propeller shaft housing, a power shaft in said power shaft housing, water intake and outlet passages adjacent the power shaft, and an intake port in the propeller shaft housing and communicating with said intake passage.

2. In a marine propulsion device provided with a vertically disposed power shaft housing, a longitudinally disposed propeller shaft housing integral therewith, water intake and outlet passages in said power shaft housing, an intake port in the propeller shaft housing and communicating with the intake passage, and a spiral interposed between said port and said passage for forcing water up said intake passage.

3. In a marine propulsion device formed with a vertically disposed power shaft housing, a longitudinally disposed propeller shaft housing integral therewith, a propeller journaled thereon, water intake and outlet passages in said housing, an outlet port opening directly adjacent the propeller, an intake port in the propeller shaft housing and communicating with the intake passage, and means mounted in the said housing for forcing water up the intake passage.

4. In a marine propulsion device provided with a power shaft housing, a propeller shaft housing formed integral therewith, intake and outlet passages in said power shaft housing, an intake port in the propeller shaft housing and communicating with the said intake passage, and a spiral interposed between said port and said passage.

5. In a marine propulsion device provided with a power shaft housing, a propeller shaft housing integral therewith, intake and outlet passages formed in said power shaft housing, an intake port in said propeller shaft housing and communicating with said intake passage, and a spiral interposed between said port and said passage for forcing water into said passage.

6. In a marine propulsion device provided with a vertically disposed wedge shaped power shaft housing having sharp edges, a gear casing on the lower end thereof, a propeller shaft housing, water intake and outlet passages adjacent the power shaft and below the normal water line, and an intake port in the propeller shaft housing and communicating with said intake passage.

7. In a marine propulsion device provided with a power shaft housing, intake and outlet passages therein, a power shaft journaled therein, a propeller shaft housing below said power shaft housing, a propeller shaft therein, and having driving connection with said power shaft, an intake port in the propeller shaft housing and communicating with the intake passage, and a spiral mounted on the propeller shaft and interposed in said passage.

8. In a marine propulsion device provided with a vertical power shaft housing, a propeller shaft housing integral therewith, intake and outlet passages in said housing, a power shaft journaled therein, and having driving connection with a propeller shaft journaled in the propeller shaft housing, a propeller mounted thereon, a spiral mounted on said shaft in the said housing, an intake port communicating with said intake passage, and a discharge port directly adjacent the propeller.

9. In a marine propulsion device provided with a vertically disposed power shaft housing, a longitudinally disposed propeller shaft housing formed integral therewith, intake and outlet passages formed in said housing and forming a continuous circuit with the water jacket of a motor, an intake port in the nose of the propeller shaft housing and communicating with the intake passage, and an outlet port in the power shaft housing directly adjacent the propeller.

10. In a marine propulsion device provided with a power shaft housing, a propeller shaft housing integral therewith, a propeller shaft journaled therein, intake and

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outlet passages in said housing and forming a continuous circuit with the water jacket of a motor, an intake port in the propeller shaft housing, and a spiral mounted on the propeller shaft and interposed in said intake passage.

11. In a marine propulsion device provided with a power shaft having driving connection with a propeller shaft journaled in a propeller shaft housing, intake and outlet passages adjacent said power shaft, an intake port in said gear casing and connecting with said intake passage, and a spiral mounted on the propeller shaft and interposed in said intake passage.

12. In a marine propulsion device formed with a vertically disposed knife edged symmetrical wedge shaped power shaft housing a propeller shaft housing formed integral therewith, and intake and discharge passages in said propeller shaft and power shaft housings opening below the normal water level.

In testimony whereof I affix my signature.

JAMES H. PIERCE.

532

Aug. 16, 1927. 1,639,339

G. W. GRASS

OUTBOARD MOTOR

Filed March 4. 1926 2 Sheets-Sheet 1

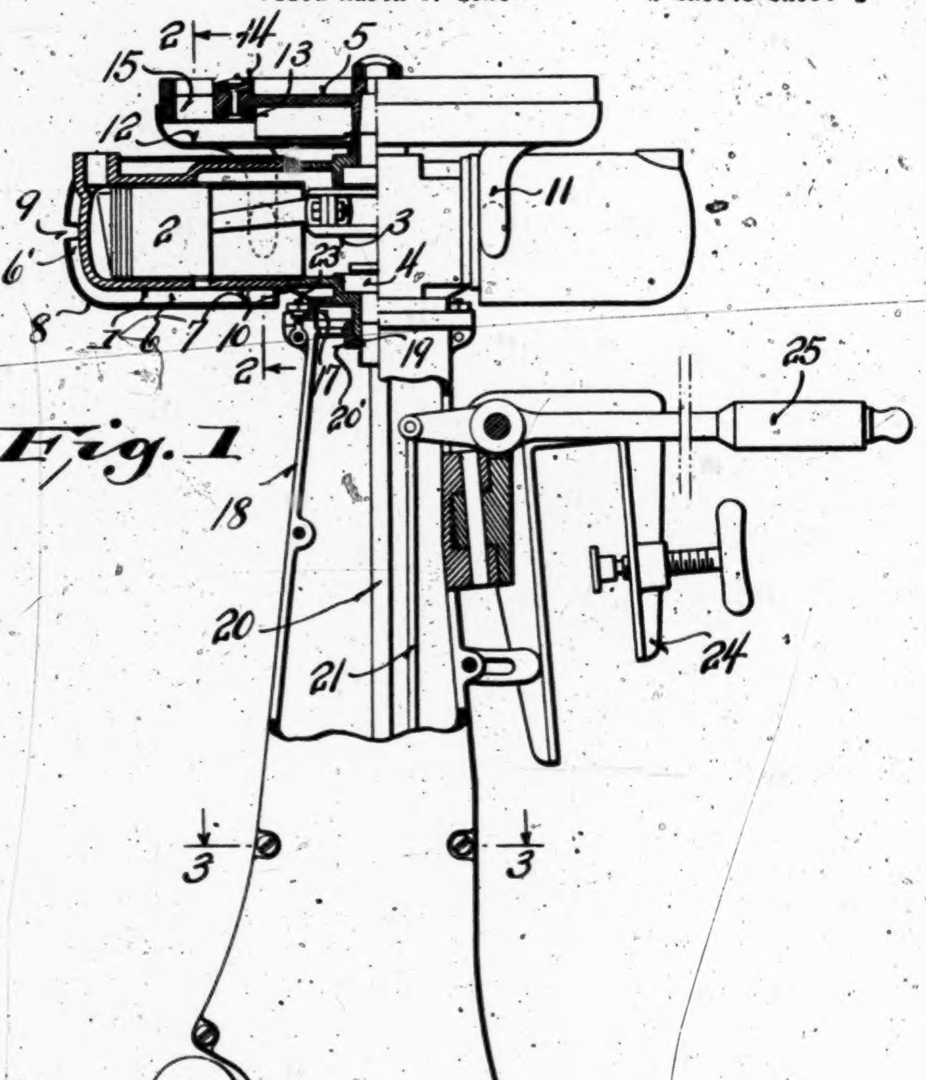

Fig. 1

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Aug. 16, 1927.

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G. W. GRASS

OUTBOARD MOTOR

Filed March 4, 1926

2 Sheets-Sheet 2

Fig. 2

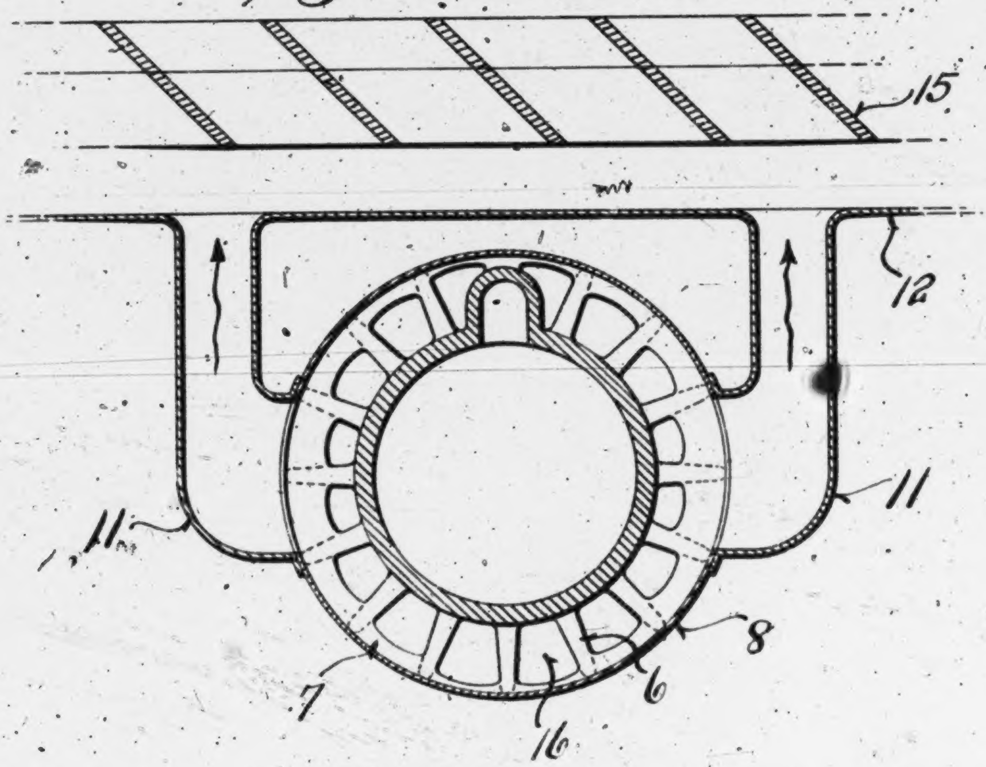
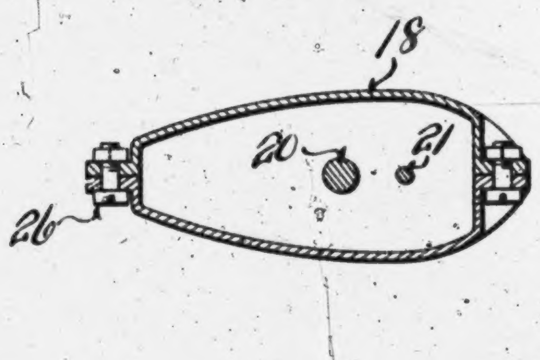


Fig. 3



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Patented Aug. 16, 1927. 535 1,639,339

UNITED STATES PATENT OFFICE.

GEORGE W. GRASS, OF MILWAUKEE, WISCONSIN.

OUTBOARD MOTOR.

Application filed March 4, 1926. Serial No. 92,265.

This invention relates to outboard motors.

In outboard motors such as those adapted for detachable association with a small boat, it has been the usual practice to provide for water cooling. This water cooling, however, entails certain complications of structure, and due to the fact that the boat is used in all kinds of water, it has been found that the water cooling systems frequently clog and give trouble.

This invention is designed to provide an outboard motor which is air cooled, and which is so constructed that the same amount of cooling air is supplied all portions of the cylinder, irrespective of the point at which the air is admitted or withdrawn from the cooling shell.

Further objects are to provide a novel form of air cooled motor in which fins are employed both radially and circumferentially of the cylinder.

Further objects are to provide a novel form of fly wheel associated with the air cooled motor so that the fly wheel itself acts as the air propelling means.

An embodiment of the invention is shown in the accompanying drawings, in which:

Figure 1 is an elevation partly in section of the motor.

Figure 2 is an enlarged sectional view approximately on the line 2—2 of Figure 1 with the fly wheel developed in the section.

Figure 3 is an enlarged sectional view on the line 3—3 of Figure 1.

Referring to the drawings, it will be seen that the motor is of the opposed piston type. It is provided with a pair of opposed cylinders 1 within which the pistons 2 operate. These pistons are connected by suitable piston rods with the cranks 3 carried by the engine shaft 4. This engine shaft projects upwardly and carries a fly wheel 5 which will be described in greater detail hereinafter. The cylinders are each provided with a plurality of longitudinal fins 6 which project radially from the body of the cylinder. These radial fins are joined at their outer ends by means of the circumferential or annular fin 7 as most clearly shown in Figure 2. The fins are surrounded by an outer shell or casing 8 which contacts with their outer edges. The radial fins are continued over the ends of the cylinders as indicated at 6′ in Figure 1, and the shell 8 is provided with an inlet aperture 9, as shown in such figure, through which the entering air may pass. This shell is closed at its inner end by means of the annular member 10 as shown in Figure 1, adjacent the inner end of the shell. A pair of conduits or pipes 11 extend outwardly from opposite sides of the cylinder as most clearly shown in Figure 2. These pipes provide the outlet passages for the air. They open through the bottom of a casing 12 whose edges are upturned into proximity to the outer periphery of the composite fly wheel as shown in Figure 1.

The fly wheel is provided with vanes arranged in a slanting manner so as to entrain or scoop up the air from the interior of the casing 12 and to project it outwardly as the fly wheel rotates. A convenient way of forming this fly wheel is to bolt a lower annular member 13 and an upper annular member 14 to opposite sides of the fly wheel as shown in Figure 1. These members are provided with vanes 15 carried jointly by the two portions as shown in Figures 1 and 2.

From Figure 2, it will be seen that as the fly wheel rotates in the direction of the arrow, air will be drawn outwardly from the casing 12 and will be sucked through the passage provided by the pipes 11. This air is drawn from opposite sides of each cylinder at diametrically opposite points.

In order to insure a uniform flow of air for all portions of the cylinder, it is to be noted from Figure 2, that the annular fin 7 cooperates with the radial fins 6 to form apertures 16 which are smallest immediately adjacent the pipe 11 and largest at the most remote points. In other words, the fins or flanges 7 are thicker, or of greater depth adjacent the pipe 11 than at other portions of the cylinder. This construction of fins insures a uniform flow of air for all portions of the cylinder.

Further, it will be noted from Figure 1, that the pairs of pipes 11 open into the casing 12 on opposite sides thereof, and thus, a very uniform flow of air is secured.

This outboard motor is provided with a flanged portion 17 which rests upon the corresponding flange of the hull or body portion 18 of the device. Further, the body of the motor is provided with a sleeve 19 which fits within a collar 20′ carried within the upper end of the body portion 18. This body portion 18 houses the vertical driving shaft 20 and the reverse rod 21 for

controlling the angle of the blades of the propeller 22 in the usual manner. Further, it is preferable to provide a slip joint for the engine shaft 4 in regard to the shaft 20 so that the motor may be lifted from the body portion 18 of the apparatus when it is desired, such motor being temporarily locked in place by means of the pivotally mounted bolts 23. This body portion is hingedly joined to clamps 24 by means of which it may be attached to the boat. A controlling lever 25 is employed in the usual manner to steer and control the setting of the propeller blades.

The body portion 18 is preferably formed of two half sections secured together, as shown, by means of bolts 26. The body portion widens in a forward and rearward direction towards its lower end and forms a stream line section as shown in Figure 3. This body portion obviously forms, in effect, the rudder for the apparatus, and may be rocked by means of the lever 25.

It is to be particularly noted that by means of this invention a novel form of air cooled motor is produced in such a way that the motor has its cylinders cooled equally at all portions by the uniformly distributed air stream. Further, it is to be noted, that an easily produced fly wheel construction is provided by this invention so that the fly wheel itself acts as the air propelling device.

Although the invention has been described in considerable detail, such description is intended as illustrative rather than limiting as the invention may be variously embodied and as the scope of such invention is to be determined as claimed.

I claim:

1. In an outboard motor, the combination of a cylinder provided with a plurality of radial fins, an annular fin joining the outer portions of the radial fins, a casing surrounding said cylinder and having an opening adjacent the head of the cylinder for the admittance of air, a pair of pipes opening into the casing at diametrically opposite points, a fly wheel provided with air propelling means, and a casing associated with the fly wheel and communicating with said pipes, the annular fin forming apertures with the radial fins of gradually decreasing size adjacent the air pipe and of gradually increasing size at points remote from the air pipe.

2. In a air cooled motor, the combination of a cylinder having radial fins, and having an annular fin joining the outer portions of the radial fins adjacent the inner end of the cylinder, a shell surrounding the cylinder and contacting with the fins, said shell having an air entrance aperture adjacent the head of the cylinder, a pair of pipes opening into said shell adjacent the inner end of the cylinder and at diametrically opposed points, the radial fin being spaced from the body of the cylinder to form apertures of a minimum size adjacent said pipes and to form apertures of a large size at points remote from said pipes.

3. An outboard motor comprising a body portion, a pair of opposed cylinders carried by the upper end of said body portion, a propeller carried by the lower end of the body portion and operatively connected to said motor, the cylinders of said motor each having a plurality of radial fins and having an annular fin joining the outer ends of the radial fins and providing with the radial fins a series of apertures of large size at diametrically opposite points and of small size at points intermediate the first mentioned points, said motor having a fly wheel at its upper end, a plurality of vanes formed on said fly wheel, a casing surrounding the lower portion of said fly wheel, a casing surrounding each of said cylinders and contacting with said fins, and a plurality of air pipes joining the fly wheel casing with the cylinder casings, such pipes opening into the cylinder casings at the above mentioned intermediate points.

In testimony that I claim the foregoing I have hereunto set my hand at Milwaukee, in the county of Milwaukee and State of Wisconsin.

GEORGE W. GRASS.

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Jan. 17, 1928.

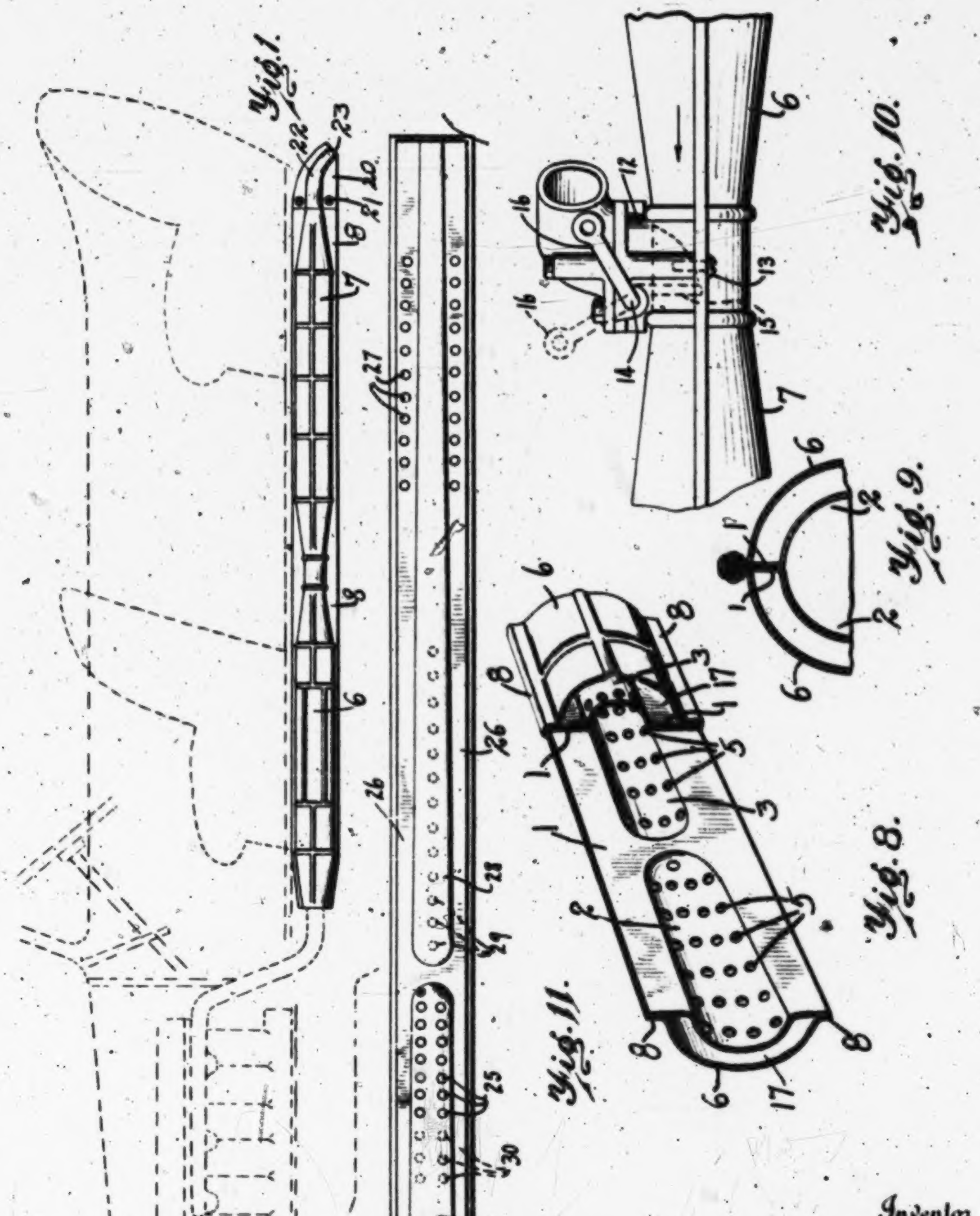
1,656,629

E. P. GRAY

MUFFLER

Filed Feb. 17, 1923

2 Sheets-Sheet 1



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By

Attorney

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Jan. 17, 1928.

1,656,629

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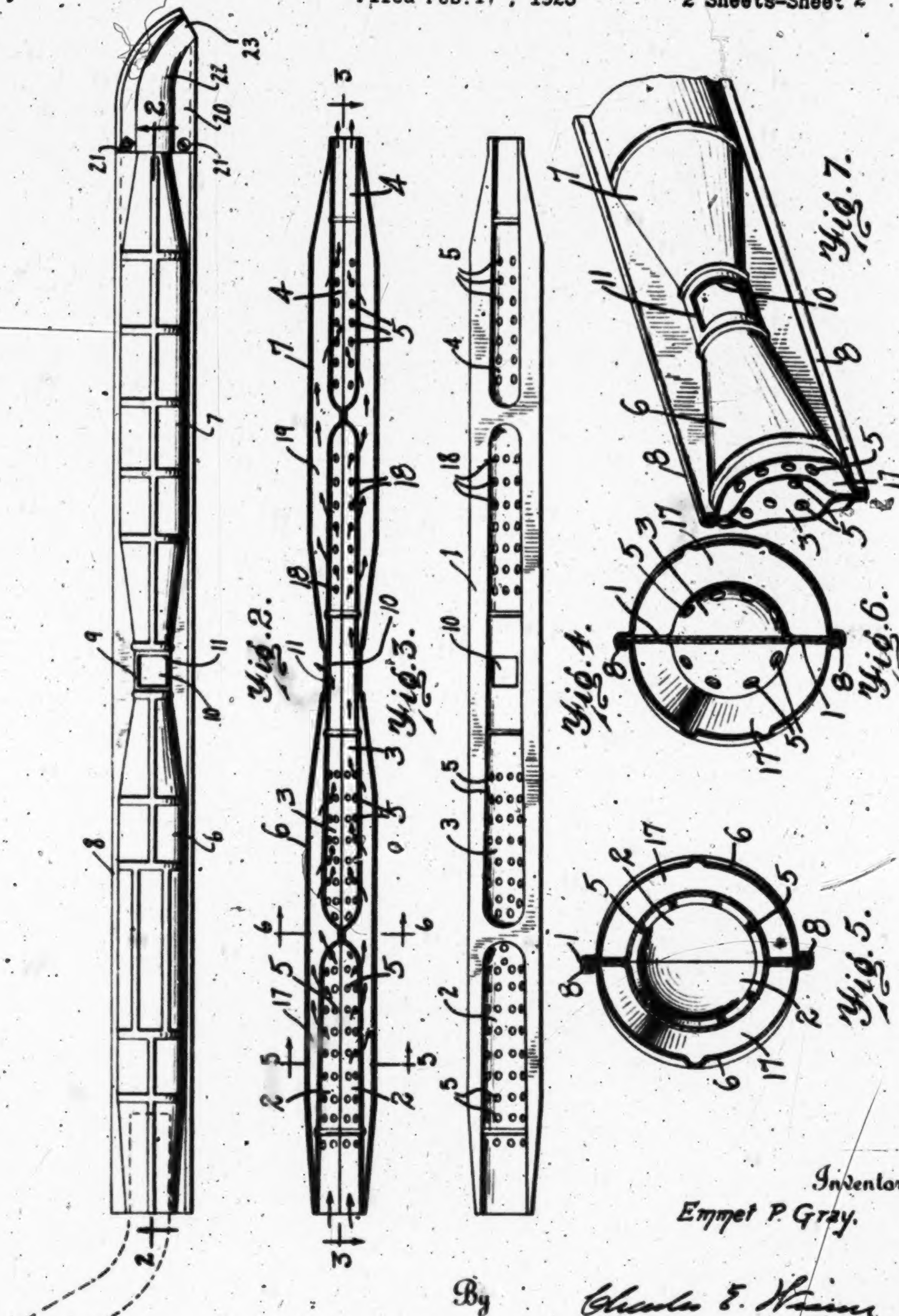
MUFFLER

Filed Feb. 17, 1923

2 Sheets-Sheet 2



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Emmet P. Gray.

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Attorney

Patented Jan. 17, 1928.

1,656,629

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UNITED STATES PATENT OFFICE.

EMMET P. GRAY, OF DETROIT, MICHIGAN.

MUFFLER.

Application filed February 17, 1923. Serial No. 619,744.

This invention relates to mufflers and the object of the invention is to provide a muffler for internal combustion engines in which the back pressure is reduced to a minimum. Another object of the invention is to provide a muffler of very simple construction and of consequent low manufacturing cost and having an efficiency above that of mufflers of the usual type. A further object of the invention is to provide a muffler of the character described which is adapted to replace the normal exhaust pipe extending beneath the body of the automobile and which when secured in place has no parts to get out of order and rattle. Another object of the invention is to provide a muffler in which the flow of gases therethrough is in one general direction due to the design and length of the muffler so that the exhaust gas is not turned back upon itself as is the case with the short cylindrical types of mufflers. A further object of the invention is to provide a muffler in which the exhaust gases enter the intake end thereof in distinct impulses from the internal combustion engine and are discharged at a steady uniform pressure so that the noise of the separate explosions is completely done away with. Another object of the invention is to provide a muffler to which a heater may be attached intermediate its ends at a point where the gases are partially expanded so that the impulse of the separate explosions is considerably reduced before the gases are carried to the heater. These objects and the several novel features of the invention are hereinafter more fully described and claimed and the preferred form of construction by which these objects are attained is shown in the accompanying drawings in which—

Fig. 1 is a view of the muffler as used with an automobile of the usual type.

Fig. 2 is a side view of a muffler embodying my invention.

Fig. 3 is a section taken on line 2—2 of Fig. 2.

Fig. 4 is a section taken on line 3—3 of Fig. 3.

Fig. 5 is a section taken on line 5—5 of Fig. 3.

Fig. 6 is a section taken on line 6—6 of Fig. 3.

Fig. 7 is a perspective view of the central portion of the muffler.

Fig. 8 is a perspective view showing how the parts are secured together.

Fig. 9 is a section showing an alternative manner of securing the parts together.

Fig. 10 is a view showing the construction of the valve secured to the center of the muffler.

Fig. 11 is a view with the upper half of the outer casing removed showing an alternative type of interior arrangement of the muffler.

As shown in Figs. 1 and 2 the muffler is adapted to be connected at the forward end to the exhaust manifold of the internal combustion engine and when used on automobiles the muffler takes the place of the usual long exhaust pipe and extends beneath the automobile body. The muffler comprises two duplicate inner parts one of which is shown in Fig. 4. Each part 1 is provided with recessed portions 2, 3 and 4 which are half round in cross section shown in Figs. 5, 6 and 8. The portion 2 is of greater diameter than the portion 3 and the portion 3 is of greater diameter than the portion 4 the said portions tapering in diameter from the forward end to the rear end of the member 1. The two parts 1 are positioned with the flat flanges engaging as shown in Fig. 5 and as the two parts 1 are exact duplicates the portions 2, 3 and 4 when placed together form cylindrical recesses. The portions 2, 3 and 4 are provided with a multiplicity of small apertures 5. The outer casing is also composed of two duplicate parts one of which is shown in Fig. 2. Each half of the outer casing comprises two semi-cylindrical portions 6 and 7 of greater diameter than the portions 2, 3 and 4 of the members 1 and are adapted to fit thereabout as shown in Fig. 5. A peripheral flange 8 is provided about each portion of the outer casing and one flange on each portion of the outer casing is adapted to be bent over the flanges of the portions 1 and flange 8 of the opposite casing as shown in Fig. 5. The several flanges thus secured together are then welded together so as to form a leak proof joint to prevent the escape of exhaust gases. The portions 6 and 7 are reduced in diameter at the center as shown in Figs. 2

and 3 and the reduced portion 9 thus formed fits closely about the center of the portions 3 of the members 1 as shown in Fig. 3. One of the members 1 of the muffler is provided with a square aperture 10 and one-half of the outer casing is provided with an aperture 11 in the portion 9 which registers with the aperture 10 as shown in Figs. 2, 4 and 7. As shown in Fig. 10 a valve portion 12 is provided having an aperture registering with the apertures 10 and 11 of the muffler and this valve portion is secured to the muffler by the screws 13 which extend through the flanges of the muffler and into threaded apertures provided therefor in the valve portion 12. A rotatable shaft 14 is provided to which the valve 15 is secured and an arm 16 is provided which may be moved to the dotted position shown in Fig. 10 to close the valve. When the valve is in the open position shown in dotted lines in Fig. 10 it extends down through the apertures 10 and 11 and restricts the passageway thus causing the gases to pass upwardly through the valve and through a heater which may be connected thereto as will be readily understood, the direction of flow of the gases being indicated by the arrow at the right of Fig. 10. When the valve is closed by moving the lever 16 to the dotted position the passageway for the exhaust gases is not restricted and the entire quantity of exhaust gases may pass directly through the chamber 3 of the muffler.

The flow of exhaust gases is shown more particularly in Fig. 3 in which the gases enter in the direction of the arrows at the left of Fig. 3 and pass outwardly through the apertures 5 in the chamber 2 and thence into the chamber 17 between the inner and outer casings. The gases then pass through the apertures 5 in the chamber 3 and through the chamber 3 and outwardly through the apertures 18 in the opposite end thereof into the chamber 19 between the inner and outer casings and thence through the apertures 5 into the chamber 4 and thence to atmosphere. I preferably provide a tail piece 20 for the muffler composed of two parts which when secured together are secured to the muffler by bolts 21 and form a conduit 22 through which the exhaust gases may pass, the diameter of the conduit 22 decreasing toward the discharge end. Due to the operation of the internal combustion engine the exhaust gases are discharged into the muffler in separate impulses caused by the explosion of gas in the cylinders of the engine but by decreasing the diameter of the chambers 2, 3 and 4 and conduit 22 the flow of exhaust gas is retarded so that it passes from the discharge end 23 uniformly without impulse or sound. In order to produce this result the muffler must be carefully designed so that the restriction to flow is not sufficient to put a back pressure on the engine but a point will be found where the separate impulses may be merged to produce a continuous flow of exhaust gases from the discharge end without building up pressure in the muffler.

A slightly alternative form is shown in Fig. 11 in which one half of the outer casing has been removed. The exhaust gases enter the chamber 24 of the inner casing and the flanges of the inner casing divide the outer casing into two compartments or chambers extending lengthwise of the muffler. The gases pass from the exhaust manifold into the chamber 24 and through the apertures 25 into the chamber on the upper side of the flanges 26 and pass through the length of the muffler and through the apertures 27 in the flanges 26 into the chamber between the casings on the lower side of the flanges. The gases then pass to the left and enter the chamber 28 through the apertures 29 which are shown in dotted lines and are open to the lower chamber between the casings, the gases passing through the chamber 28 and being discharged therefrom to atmosphere. The chamber 24 is provided with apertures 30 on the lower side which are shown in dotted lines and are open to the chamber between the inner and outer casings on the lower side of the flanges 26. These apertures 30 are provided to relieve pressure when a backfire occurs in the muffler and the exhaust gases pass from the apertures 30 through the lower chamber between the casings and into the apertures 29 and through the chamber 28 to atmosphere. If the apertures 25 were the only means of exit from the chamber 24 a backfire would produce pressure on one side only of the inner casing and would warp the muffler out of shape, but by providing the apertures 30 the pressures are equalized on each side of the chamber 24 so that the inner casing will not be forced out of shape. This type of muffler while not varying greatly from the type shown in Fig. 3 causes the gas to travel a greater distance before being discharged.

From the foregoing description it becomes evident that the device is very simple and efficient in operation, is composed of few parts and is of consequent low manufaucturing cost, may be easily assembled and provides a device which accomplishes the objects described.

Having thus fully described my invention, its utility and mode of operation, what I claim and desire to secure by Letters Patent of the United States is—

1. A muffler comprising an inner casing, an outer casing thereabout providing a chamber, the outer casing intermediate its length being contracted to engage about the inner casing and dividing the chamber therebetween the casings into two parts, the inner casing being adapted to receive exhaust

gases and being formed of a series of chambers closed one to the other, the chambers of the inner casing having apertures whereby the gas passes from the inner casing to the chamber between the casings and thence to the next chamber of the inner casing, there being an aperture provided in both casings at the intermediate point of contact permitting flow of gases from the muffler subsequent to a partial expansion of the gases, and a valve for controlling the said aperture adapted when moved to open the aperture to extend into the passageway for gases.

2. A muffler comprising an outer substantially cylindrical sheet metal member formed of two flanged parts, an inner sheet metal casing formed of two similar flanged parts, the flanges of both casings being secured together and fixedly supporting the inner casing within the outer casing providing a chamber between the casings closed to atmosphere and the inner casing being formed of separate chambers provided with apertured walls whereby a flow of gases from one chamber to the other in the inner casing passes through the outer chamber, the last of the series of chambers of the inner casing being open to atmosphere.

3. A muffler comprising an outer casing of sheet metal formed of two similar flanged parts, an inner sheet metal casing also formed of two similar flanged parts, the flanges of the inner casing extending between the flanges of the outer casing, the several flanges being secured together to seal the same and positioning the inner casing in spaced relation with the outer casing and providing chambers exteriorly of the inner casing and on opposite sides of the flanges thereof, there being apertures provided in the inner casing and flanges whereby gases passing into the inner casing pass into the said chambers on opposite sides of the inner casing and thence to a succeeding chamber of the inner casing.

4. A muffler comprising an outer casing of sheet metal formed of two similar half parts, an inner sheet metal casing enclosed thereby also formed of two similar half parts each provided with flanges and extending longitudinally of the outer casing, the flanges of the inner casing being utilized to support the same centrally within the outer casing and the inner casing being arranged to receive the exhaust gases at one end, and a tail pipe at the opposite end of the inner casing.

5. A muffler comprising an inner casing formed of two parts, each part being formed to provide a series of longitudinal pockets and the two parts when secured together completely enclosing the pockets, an outer casing formed of two parts forming chambers about the inner casing when secured together, the pockets of the inner casing being apertured to allow communication from one pocket to the outer chamber to the next succeeding pocket.

6. A muffler comprising an outer casing of sheet metal formed of two similar flanged parts together forming a hollow casing, an inner silencing member also of two similar flanged parts together providing a series of hollow chambers in alignment longitudinally and separate one from the other, the inner member being in spaced relation with the outer casing providing a chamber therebetween the flanges of the inner member being supported between the flanges of the outer member and the walls of the inner chambers having apertures, the wall of the outer member being reduced intermediate its length to closely engage the wall of an inner chamber, the arrangement providing for a flow of fluid from an inner chamber to a surrounding chamber and thence to an inner chamber successively from end to end of the device.

7. A muffler formed of sheet metal comprising an outer cylindrical shell of two similar half parts flanged at each edge and an inner silencing member of sheet metal formed of two similar half parts flanged at each edge, each inner half part having depressions formed therein providing separate chambers when the two inner parts are placed together, the flanges of the two inner parts being secured between the flanges of the two outer parts forming two chambers of the space between the inner and outer shells, the walls of the said pockets having apertures providing for communication between the inner and other chambers.

8. A metal muffler comprising an outer sheet metal shell formed of two parts each provided with a lateral flange at each edge, an inner silencing member in spaced relation with the outer shell providing a chamber therebetween, the inner member being formed of two similar parts provided with a lateral flange at each edge and formed to provide a series of longitudinal pockets apertured to provide communication between the inner silencing member and the chamber between the inner and outer members, the flanges of the inner member being secured between the flanges of the assembled outer member, the arrangement providing for an intake of gases at one end and a discharge thereof at the other.

9. In a muffler, an exhaust conduit, the walls of which are flattened intermediate the ends to provide an obstruction preventing the passage of the gases therethrough, the said walls each side of the obstruction being apertured, and an outer casing of sheet metal flattened at its ends to clamp about the tubular member and providing a chamber about the tubular member into which the exhaust gases are discharged from the conduit forward of the obstruction and from which the

gases pass to the exhaust conduit to the rear of the obstruction.

10. In a muffler, a tubular member providing a passageway for exhaust gases, said member having an obstruction intermediate its ends preventing the passage of the gases longitudinally therethrough, said tubular member having apertures forward of and to the rear of the obstruction for the escape and the reentrance respectively of the exhaust gases, and an outer sheet metal shell flattened at its ends to clamp about the tubular member and positioned to receive the exhaust gases discharged from the forward series of apertures and to guide the same to the rear series of apertures.

11. A muffler comprising an outer casing of sheet metal formed of two similar half parts, the end portions thereof being contracted to form apertures of smaller diameter than the diameter of the casing, an inner sheet metal casing also formed of two similar half parts provided with complemental flanges extending longitudinally of the outer casing, the contracted end portions of the outer casing engaging about and clamping the inner casing at the ends, the flanges of the inner casing being utilized to support the same centrally within the outer casing and the inner casing being arranged to receive the exhaust gases at one end and a tail pipe through which the gases are discharged beyond the muffler at the opposite end.

In testimony whereof, I sign this specification.

EMMET P. GRAY.

546

Jan. 1, 1929. 1,697,794

S. A. STRANAHAN

EXHAUST MANIFOLD MUFFLER

Filed Feb. 28, 1927

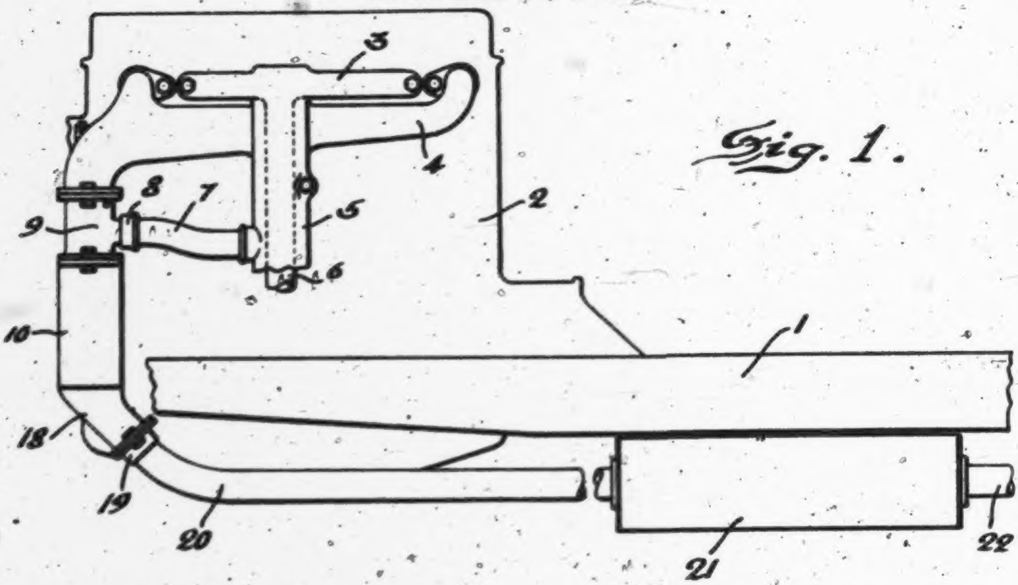
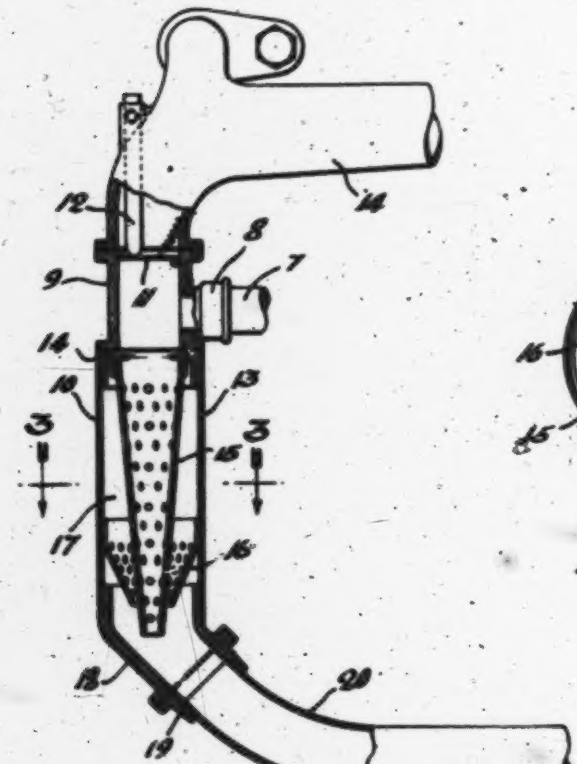


Fig. 1.



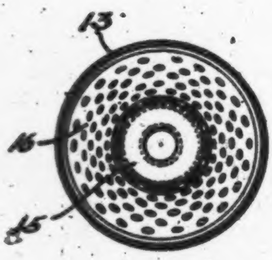


Fig. 3.

Fig. 2.

Inventor

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By Blackmore, Spencer & Flint

Attorneys

Patented Jan. 1, 1929. 547 1,697,794

UNITED STATES PATENT OFFICE.

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EXHAUST-MANIFOLD MUFFLER.

Application filed February 28, 1927. Serial No. 171,709.

This invention relates to internal combustion engines and particularly to silencers or mufflers for the purpose of dampening and quieting the exhaust from the explosion chambers.

The object of the invention is to provide an improved device of simple construction for the purpose of minimizing noises due to discharge of spent products of combustion.

A further object is to provide an auxiliary muffler, located adjacent the discharge ports of the engine, to break up the sharp explosions and diffuse the draft of spent gas and allow their expansion, without the production of any appreciable back pressure, before the gases enter and pass thru the exhaust conduit leading to the regular concussion muffler, thereby eliminating drumming noises in the exhaust conduit.

Other objects and advantages will be apparent from the following specification taken in connection with the accompanying drawing of a preferred embodiment of the invention, and wherein Figure 1 is a side elevation, illustrating a multi-cylinder engine mounted on the chassis frame of a motor vehicle, with the present muffling arrangement applied thereto; Figure 2 is a vertical sectional view of the auxiliary silencer, and Figure 3 is a transverse section taken on line 3—3 of Figure 2.

Referring to the drawing, the reference character 1 indicates one of the longitudinal side members of a vehicle chassis frame and 2 is a multi-cylinder internal combustion engine, supported upon the chassis frame. Fuel is supplied to the combustion chamber of the engine, by means of the intake manifold 3 and the spent gases are discharged from the combustion chamber into the exhaust manifold 4, as will be readily understood. In the event it is desired to utilize exhausted gas to preheat the fresh fuel, a dependent jacket 5 of the exhaust manifold may be provided to surround the fuel intake pipe 6. To secure circulation of hot gases thru the jacket 5, a conduit 7 is connected to the lateral spur 8 of a T-coupling 9, between the discharge end of the exhaust manifold and the auxiliary muffler or dampener 10. A pivoted valve 11 may be provided adjacent the discharge end of the exhaust manifold to control the amount of gases to be by-passed thru the jacket 5 and conduit 7, the valve being actuated either manually or automatically, as for instance, by means of a thermostatic element 12 in the exhaust manifold 4. Annular flanges at the opposite ends of the T-coupling 9 are bolted respectively to the exhaust manifold 4 and muffler 10. Preheating of the fuel charge is a more or less common practice in automotive engine design and the arrangement shown is one of conventional form. Not being a part of the present invention, the arrangement to preheat the fuel may be entirely omitted, in which case the exhaust manifold and auxiliary muffler would be directly connected with each other.

The muffler or dampener 10, is shown as consisting of a cylindrical casing 13 having at the inlet end, an annular head or ring 14 carrying a uniformly tapering tubular passageway or conical nozzle 15, which extends coaxially thru the casing 13, and slightly beyond a frusto-conical baffle wall 16, which in turn is secured at its periphery or base to the casing 13. The central opening at the smaller end of the frusto conical wall 16, is slightly larger than that portion of the nozzle surrounded by the end of the wall, affording a clearance or passageway therebetween. The walls of the conical tube 15 and casing 13, are spaced from each other to afferd an expansion chamber 17, and both the conical tube 15 and baffle 16 are perforated, to permit passage of gases into and out of the expansion chamber 17. At the outlet end of the casing 13, is located an elbow fitting 18, having an annular flange at the end thereof, to which is bolted the flange of a coupling 19, on the end of the exhaust conduit 20. The exhaust conduit 20 leads along the chassis frame, a considerable distance to the rear, where the customary detonation muffler 21 is provided to completely quiet down the noises, permitting the gases to freely expand and noiselessly escape to atmosphere thru the final discharge pipe 22.

It will readily be seen, that when the draft of spent gases leaves the exhaust manifold 4, an immediate diffusion and expansion occurs, which dampens the sharp explosions and obviates drumming noises in the exhaust conduit 20. A portion of the spent gases rushing thru the tapering passageway 15, are diverted thru the lateral perforations and into the expansion chamber 17, materially relieving the pressure, while the gases passing out the small end of the nozzle 15, induce a partial vacuum about the outside of the nozzle to withdraw

gases in the expansion chamber, past the frusto-conical baffle wall 16, the flow then proceeding thru the exhaust conduit 20 to the muffler 21. The tapering wall of the baffle 16 results in a tendency for the gases to crowd to the center and pass the baffle thru the central opening at the smaller end of the baffle, whereby a slight additional vacuum is created about the outside of the wall to draw some of the gases thru the perforations and further break up the draft. Thus the draft of exhaust gases passes rapidly thru, and is thoroughly diffused by, the auxiliary muffler 10, without setting up any effectual back pressure on the engine.

While the invention has been described more or less specifically, it is to be understood that it is not limited to the exact form shown, but that such obvious modifications may be made as come within the scope of the appended claims.

Having described my invention, I claim:

1. In a device of the character described, a cylindrical casing, a conical tubular passageway extending axially thru the casing in spaced relation therewith, the space between the walls of passageway and casing forming an expansion chamber, the wall of the passageway being provided with lateral perforations to establish communication between the interior of the passageway and expansion chamber, and a frusto-conical perforate baffle wall secured at its periphery to the casing and arranged coaxially of the passageway and having a central opening thru which the smaller end of the passageway projects to a point slightly beyond the baffle wall, said central opening being of larger diameter than that portion of the passageway extending therethru to afford an outlet opening at the smaller end of the frusto-conical wall.

2. In a device of the character described, a cylindrical casing, a conical tubular passageway extending axially thru the casing in spaced relation with the walls of the casing, forming thereby an expansion chamber communicating with the passageway by means of perforations in the wall of the passageway, the direct flow of gases thru the conical passageway creating a partial vacuum at the outlet, and a conical baffle wall co-axially arranged in said casing and having perforations therein and an opening at the end thereof through which opening said tubular passageway projects to a point beyond the wall, the direct flow of gases thru the opening creating partial vacuum to augment that created at the outlet of the conical passageway to withdraw the gases in the expansion chamber.

3. In a device of the character described, a cylindrical casing, a frusto-conical baffle wall secured at its base to the wall of the casing, a perforate conical tube secured at its base at the inlet to said casing and projecting through an opening in the baffle wall to a point therebeyond, whereby the flow of gases through the outlet of said tube serves to draw gases past the baffle wall.

In testimony whereof I affix my signature.

SAMUEL A. STRANAHAN.

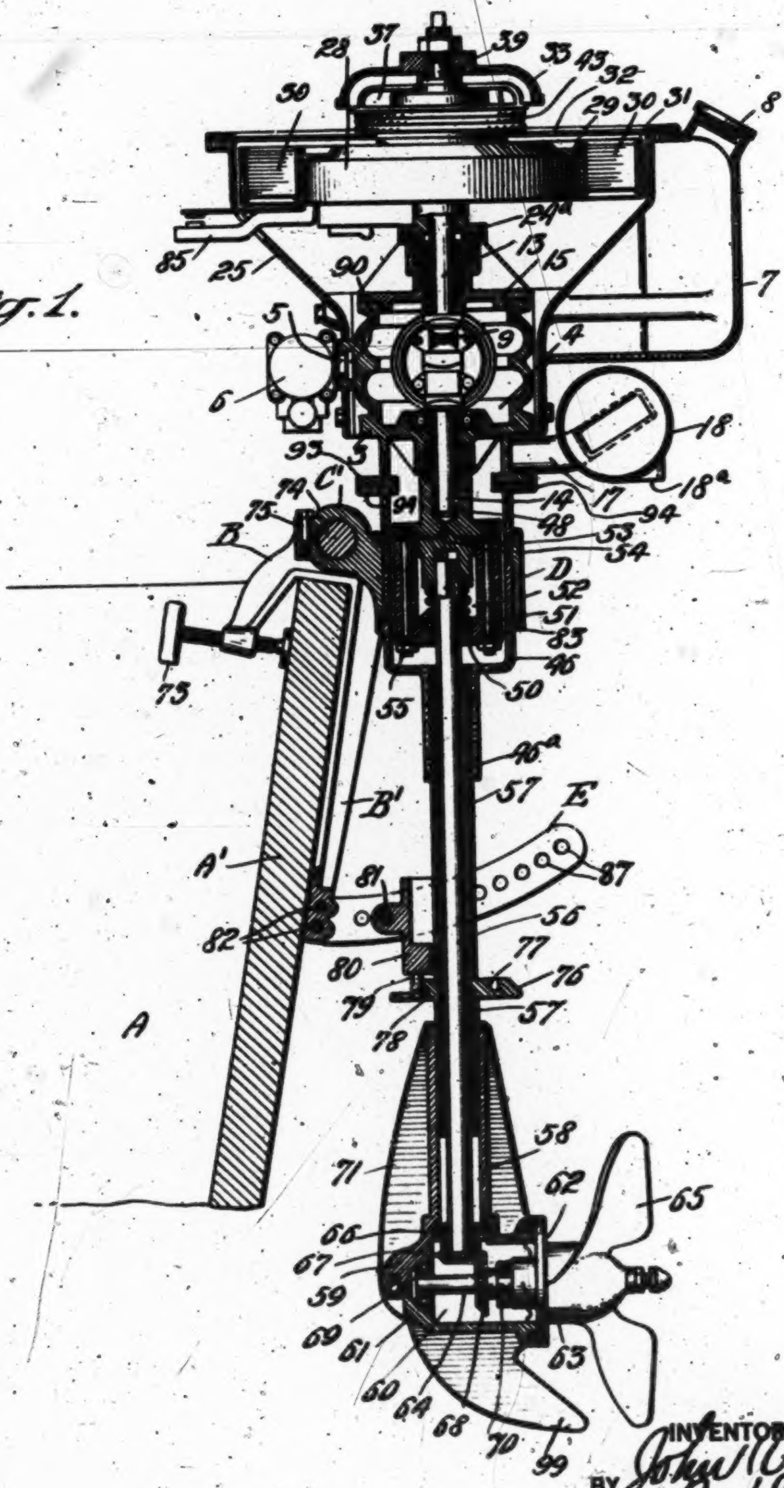
550

Oct. 29, 1929. **J. V. RICE, JR** **1,733,361**

OUTBOARD MARINE MOTOR

Filed Dec. 9, 1927 4 Sheets-Sheet 1

Fig. 1.



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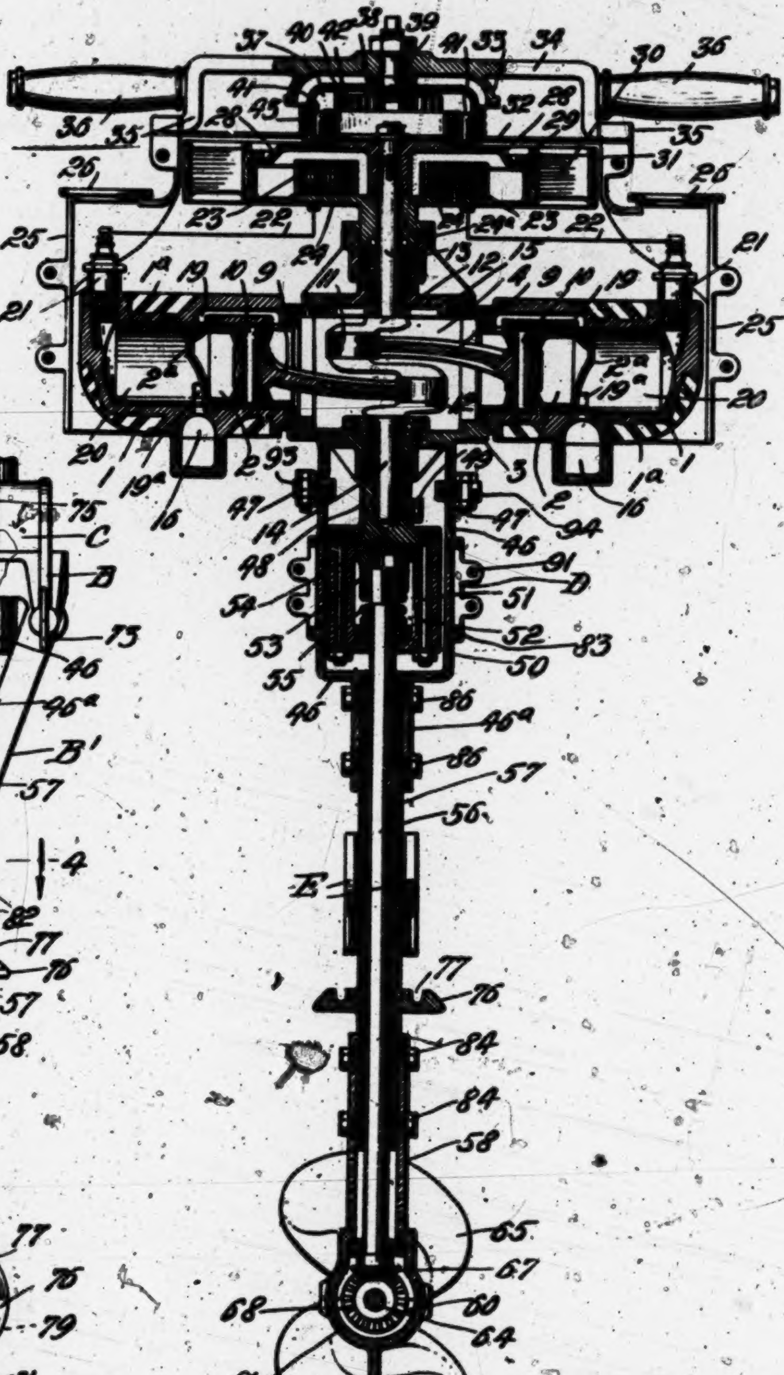
OUTBOARD MARINE MOTOR

Filed Dec. 9, 1927

4 Sheets-Sheet 2

Fig. 2.



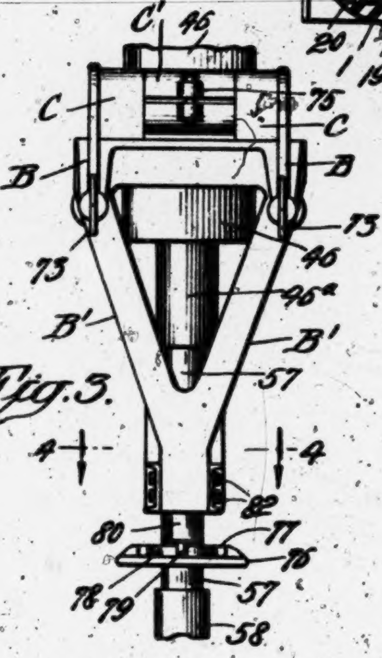
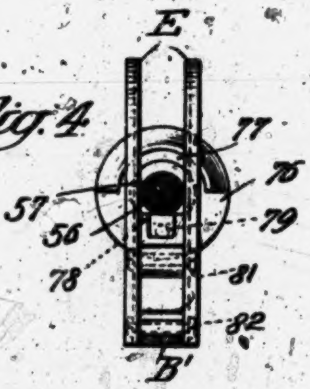


Fig. 3.

Fig. 4



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OUTBOARD MARINE MOTOR

Filed Dec. 9, 1927 4 Sheets-Sheet 3

Fig. 5.

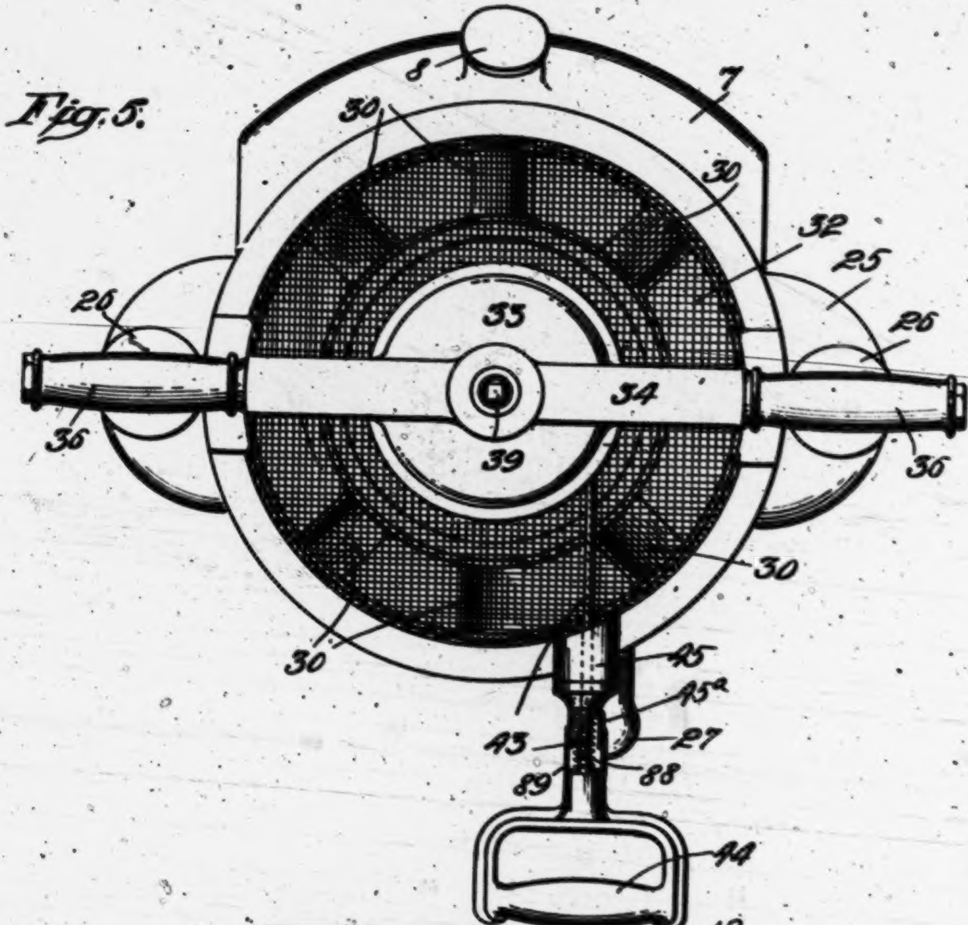
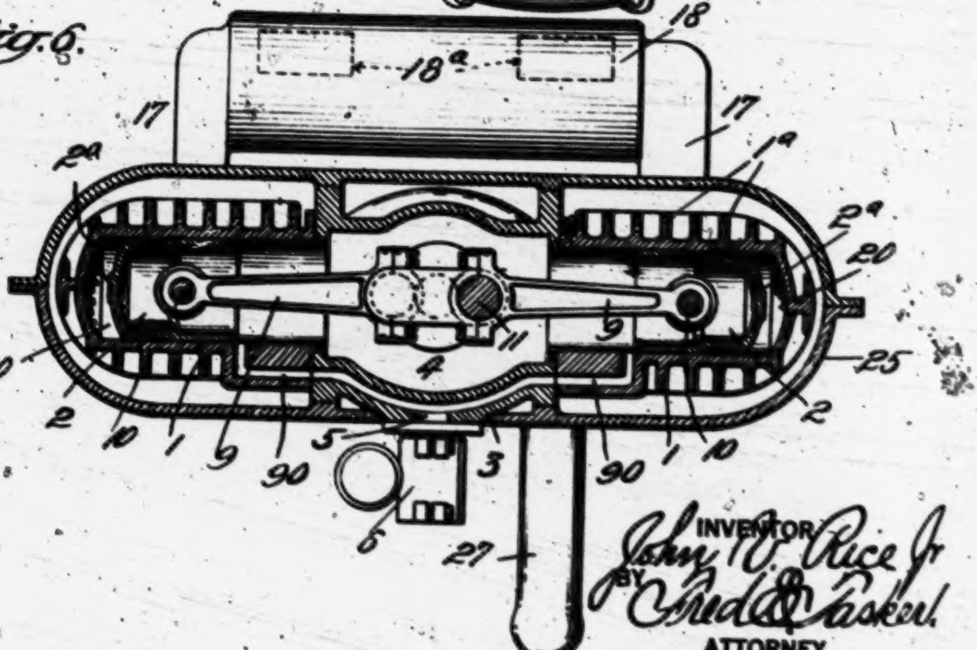


Fig. 6.



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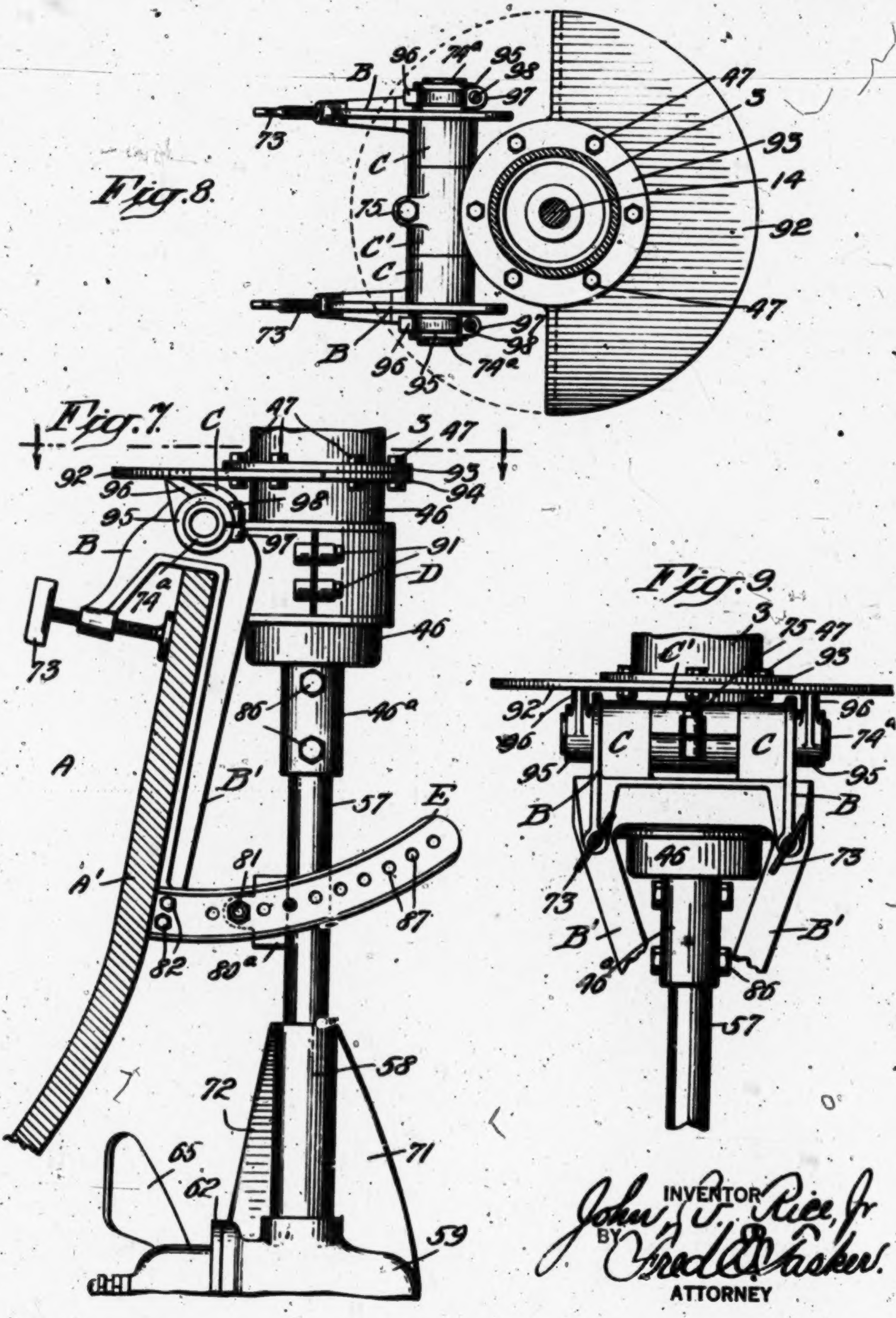
556 Oct. 29, 1929. J. V. RICE, JR 1,733,361

OUTBOARD MARINE MOTOR

Filed Dec. 9, 1927 4 Sheets-Sheet 4



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Patented Oct. 29, 1929 1,733,361

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UNITED STATES PATENT OFFICE

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OUTBOARD MARINE MOTOR

Application filed December 9, 1927. Serial No. 238,736.

This invention refers to certain new and useful improvements in marine motors of the kind commonly denominated as outboard motors or outrigger motors that are adapted for use particularly with racing boats or other small watercraft in the operation of which a very great rate of speed is atttained, the motor being hung upon the stern at a suitable clearance therefrom and having in its own unitary combination the motor, propeller and rudder.

My leading objects are to promote speed, provide easy and effective reversing means under all conditions, prevent the breaking of the main shaft when anything clogs the propeller and arrests its revolution, simplify the combination of parts and enable the driving energy to be developed with a very small amount of fuel in proportion to the power generated; furnish simple means for attaching or detaching and reversing the position of the motor on the boat's stern, permit the quick substitution of new parts when needed, and other quite obvious objects.

For these and manifold other purposes which will appear as I describe one of the preferred embodiments of the invention, I premise my detailed description with the statement that the invention may be said to consist essentially in the construction, arrangement, and combination of parts, substantally as will be hereinafter described and claimed.

In the accompanying drawing illustrating my invention:

Figure 1 is a longitudinal vertical section of my improved gasoline overhung marine motor.

Figure 2 is another similar longitudinal section of the same in a plane at right angles to the section of Figure 1.

Figure 3 is a detail elevational view of the rear clamping devices for supporting the motor on the boat, the same being shown removed from the boat.

Figure 4 is a horizontal section on the line 4, 4, of Figure 3.

Figure 5 is a top plan view of the whole motor.

Figure 6 is a horizontal sectional plan view midway through the cylinders.

Figure 7 is an enlarged side elevational view similar to a part of Figure 1, of an alternative means for supporting the motor in a reversed position so that it may drive backward instead of forward.

Figure 8 is a top plan view of the same.

Figure 9 is a partial elevational view of the alternative form, similar to the view of the other form in Figure 3, the mechanism being shown off the boat.

Like characters of reference denote like parts throughout all the different figures of the drawing.

The main mechanical engine theme employed by me for driving the propeller in a speed or other boat is a multicylinder internal combustion engine located cross-wise or transversely at right angles to the main engine shaft, which latter is in line with the sections of the engine crankshaft, there being a species of yielding means between two of these sections serving as an elastic connection to prevent unyielding action of the propeller when caught or fouled, permitting the engine to run even though the propeller is held stationary, whereby I prevent accidents and allow an easy and adaptable revolution of the shafting and engine elements and connections.

There may be any number of the explosion cylinders 1 containing pistons 2. In the present embodiment of the invention as illustrated I have shown two cylinders 1, situated opposite to each other, but there may be any number, either multiples of two or three, or any other number. The cylinders 1 are combined with the central crank case 3, having an interior fuel chamber 4 with a fuel inlet 5, to which leads a fuel supply, and a carbureting means 6 that is connected with the gasoline tank 7 on the side of the main frame of the motor and having filling cap 8. The inlet 5 delivers through passages 90 into the fuel chamber 4. The pistons 2 have piston or connecting rods 9 pivotally attached thereto by means of the pins 10, said rods 9 being also pivoted at their opposite ends by pivots 11 to the crank arms 12 which are

connected to the main engine crank shaft sections 13 and 14. These shaft sections 13 and 14 are axially aligned with each other and are supported in bearings in the castings or plurality of castings that enclose the crank or fuel chamber 4, the wall of said chamber being composed of several parts if preferred for convenience; thus the main section 3 of said chamber wall, as indicated in Figures 1 and 2, has a cover casting 15 bolted at one side thereof which provides a bearing for shaft section 13, and opposite thereto the section 3 provides a bearing on that side for the shaft 14, both bearings for shafts 13 and 14 having any suitable ball bearings, packings, covers, glands, and other customary accessories.

The walls of cylinders 1 may be cast with external ribs 1^a to furnish radiation for air cooling, or may have other cooling means. Each cylinder has an exhaust opening 16 from which pipes 17, 17, run into the muffler drum 18, with exhaust outlets 18^a, the details of which muffler may be of any well-known kind and need not be shown. Each cylinder also has a port or plurality of inlet ports 19 that open into the explosion bore 20 of the cylinder between the piston 2 and the cylinder head, and through these ports 19 the fuel mixture flows into explosion chambers 20 from the fuel chamber 4. Each cylinder 1 also has a port or series of outlet ports 19^a in the opposite wall of the cylinder, opposite the inlet ports 19 opening out into the exhaust outlet 16. By referring to Figure 6 it will be seen that the fuel supply passages 90 open into the central fuel chamber 4 when the pistons 2 reach their extreme limit in the heads of the cylinders 1. During the remainder of the piston movement the ports at the ends of passages 90 are covered. When the pistons are at the other end of their stroke, as seen in Figure 2, the ports 19 establish communication between the supply chamber 4 and the explosion chambers 20, so that a new charge is introduced, and at this same time the exhaust ports 19^a are open. The inner ends of pistons 2 may have a ported skirt to coincide at this time with the end of ports 19 nearest chamber 4, and thus give a more exact piston movement. In the explosion chambers 20 are spark plugs 21 wired by conductor 22 to the coils 23 of magneto 24. The pistons 2 are preferably made hollow and with a central projection 2^a from which inclined surfaces lead to the perimeter of the pistons. The explosions occur in both cylinders simultaneously. When the explosion occurs in chamber 20 by the ignition of the charge therein previously compressed by the movement of piston 2 towards the cylinder head, the piston will travel quickly to the other end of the cylinder and uncover ports 19 to admit a new charge on top of the exhaust of the spent products of the explosion through ports 19^a that are uncovered at the same time. See Figure 2. During this operation the piston projection 2^a functions to divide the outgoing burnt gases from the new incoming charge and the inclined surfaces guide the incoming and outgoing gases, in the proper direction. Both cylinders operate alike and the explosions in both take place simultaneously so that the shaft sections 13 and 14 rotate in unison in the axis of the machine. As soon as the explosion chambers 20 receive a new charge the return of the pistons compresses the charge in each chamber, and also the suction of the pistons in this movement draws in more fuel through intake 5 and passages 90 into the fuel supply chamber 4.

The cylinders 1 are in the same transverse plane and placed end to end, the piston rods 9 being preferably curved to bring the cylinders thus into line, and they are preferably covered or housed within an outer drum 25, of some suitable thin metal, having one or more handles 27 with which the whole machine may be easily steered, directed, guided and turned. The drum 25 is narrower below near to cylinders 1 and widens out above to include and cover the magneto and ignition means and their connections, the fan or blower and more or less of the self-starting mechanism, as clearly shown in Figures 1 and 2. Opposite the spark plugs 21 the drum 25 has openings to give access to said plugs and contiguous parts, said openings having covers 26.

The drum 25 is open at the thinner or smaller end adjoining casting 3 so that the cooling draft generated by the fan may flow through alongside of the heated cylinders, see Figures 1 and 2. The magneto 24 is preferably provided with a contact device, circuit closer, or other electric control 85, easy to manipulate, for shutting off the engine or controlling the ignition, and the details of this may vary widely, and I mean only to indicate some conventional form of this device.

Within the drum 2 which is suitably shaped to receive it is the magneto to which I am alluding and which is of any preferred construction and preferably has a frame 24 which is integral with central hub 24^a, which in conjunction with crank case cover plate 15 provides a rigid securely-packed stationary bearing, including a ball or roller bearing for the main shaft section 13. Surrounding main magneto or ignition device 24 is a casing 28 whose hub is keyed firmly to the end of shaft section 13 so as to be revolved thereby. An outer peripheral band 29 attached to cylindrical casing 28 carries a series of fan blades 30 which lie between said band 29 and a concentric outer band 31 that revolves within drum 25, the fan being protected by the screen or wire mesh outer

cover 32 attached to any suitable rigid cover, as for example the edge of the upper open end of drum 25. The fan therefore generates a volume of air pressure that flows through drum 25 and acts against the cylinders 1 and other parts to cool the same. The detailed construction of the fan may vary widely. The use of air cooling for the motor in a marine engine of this kind is very important and useful and presents large and substantial novelty. While the screen 32 has its outer periphery attached to drum 25, its inner circular edge, it being of annular form, is allowed to loosely surround the starter mechanism, which is covered by a convex or dome shaped plate 33 forming the middle part of a handle frame 34, whose ends at 35 are fastened to the edge of drum 25, and having handles 36, see Figure 2, while the central dome proper 33 covers the revolving starter drum 37 having a central hub 38 by means of which it is revolvably mounted on a stationary journal or pin 39 bolted or fixed centrally in handle frame 34. Secured to the fan drum 28 and also to the end of main shaft 13 is an inner starter drum 40 which is concentric with main starter drum 37. A suitable clutch device is used to connect the concentric drums 37 and 40 consisting of balls or rollers 41 that let into angular notches in the outer face of drum 40 or the inner face of drum 37 that encircles drum 40, the same being a well known form of ball or roller clutch, so that when the drum 37 is rotated in one direction the roller clutch will cause drum 37 to engage or grip drum 40 and revolve it, and when the drum 37 revolves in the opposite direction the rollers will unclutch and will release the drums 39 and 40 from each other. Drum 37 has a channel or groove on its outer surface in which winds a cord or cable 43 having one end attached to drum 37 and the other provided with a handle 44, the cord running out through a supporting guide 45, to bring it into a convenient position to be grasped for use. By pulling on the handle 44 the cable 43 will rotate drum 37, which, being clutched to drum 40, will give an initial rotary impulse to the shaft 13, the pistons and other parts, so that the engine may begin to function and cause the continued rotation of said main shaft and the operation of the propeller. After the cord 43 has been pulled out to its full length, an internal coiled spring 42 with one end attached to the inside of drum 37 and the other end attached to the stationary pin 39 on handle 34, on which pin the convex main starter drum 37 is journaled, will operate to return the drum 37 to its former position, winding up the cord 43 again in its groove so that it will be ready for another pull. Every time the cord 43 is pulled out the spring 42 will be coiled up so as to be ready to rotate drum 37 back. A few pulls, perhaps one, will be sufficient to start the engine. Thus I furnish a simple but very efficient starter for my marine motor.

Referring to Figure 5 the cable guide 45 is shown provided with a short tube 45ᵃ that telescopes with a tube 89 that forms part of handle 44. Within the telescoping tubes 45ᵃ and 89 is a spring 88 surrounding the portion of cable 43 in said tubes and tensioned against the inner ends of the tubes. Spring 88 forms a safety device to take up the rebound in case the first explosions exert such a sudden strain on the cable as to pull and otherwise break handle 44 or other parts.

The casting 3 of crank case 4 has at the bottom a suitable bearing construction including a ball bearing for the main shaft section 14. Said casting 3 is flanged or otherwise shaped at 93 to permit a casing 46 to be bolted thereto by bolts 47 passing through flange 94 on casing 46 and also the flange 93, said casing having a generally cylindrical shape and being vertically below the crank chamber.

Inside of casing 46 the lower end of the shaft section 14 enters a bearing block 48 in which it is securely held by a set screw or bolt 49. The block 48 has a recessed frame 50 bolted thereto by bolts 51 and provided with an interior chamber 52. In the upper part of chamber 52 is a block 53 provided with an upper V-shaped rib, flange, or projection 54 that enters a correspondingly-shaped groove or recess on the under side of the bearing block 48, the rib or projection 54 being urged closely into the said V-recess by means of a spring 55 bearing against the under side of block 53, which spring 55 is seated in the lower part of chamber 52 on the bottom section of casting 50. Thus the two members 48 and 53 are securely connected together so that they may rotate in unison, but the connection between them is more or less elastic so that it may yield if an obstacle temporarily gets in the way of the propeller, as I shall presently explain more fully.

The block 53 has an angular bore therein which is slidably entered by the upper squared or angular end of the vertical shaft 56, which is another section of the engine crank shaft being in line with sections 13 and 14. The revolution of the engine shaft 14 will obviously through the connecting blocks 48 and 53 rotate the shaft 56, but if an agency interposes to hold the shaft 56 stationary the engine shaft 14 will continue to revolve, for rotatable block 48 will ride over the temporarily stationary block 53, since the angular projection 54 in the angular recess in block 48 permits the block 48 to rotate on block 53 when the latter is arrested.

The members 48 and 53 which are thus yieldingly joined together to permit a certain elasticity, together constitute a connection between the main shaft section 14 and

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the long aligned shaft section 56 which drives the propeller shaft and is housed in a tube 57 that is secured to the lower end of the chamber 46. A convenient way of connecting tube 57 with chamber 46 is to provide the lower side of chamber 46 with a tube 46ª and cause the top end of tube 57 to telescope tightly therein; while the lower end of tube 57 telescopes tightly in the upright tubular part 58 of a submergible rudder frame 59 which has a chamber 60, formed in any desirable way, as for example by securing a plate 61 to the frame 59 and then attaching a cover 62 to the outside of the chamber 60, in which cover is a bearing 63 for the horizontal shaft 64 of the propeller 65.

The tube 57 is bolted within tube 46ª by means of bolts 86; and the other end of tube 57 is bolted in tubular part 58 by means of bolts 84; this being one convenient way of arranging the parts.

The long vertical engine shaft 56 that is housed as described has its upper end squared or angularly shaped to enter a square or other recess in the under side of yielding block 48; and the lower end of this shaft is held in a ball bearing 66 in housing 58 and carries a bevel pinion 67, which meshes with another bevel pinion 68 on the propeller shaft 64. The shaft 64 is carried in the ball bearings 69 and 70, the latter being combined with bearing 63. Further the frame 59 and its subframe 61 may have rudder blades or flukes 71, 72, and 99 projecting in any direction to facilitate the steering movement and operation in the water.

On shaft 64 is the screw blade propeller 65, having blades of any number and design. The shaft 56 which is a part of and is actuated by the rest of the main engine crank shaft as described transmits motion to the propeller shaft and turns the screw in the usual manner and will drive the boat forward or back, accordingly as the screw is placed.

Obviously this outboard motor may be hung on the stern of any kind of craft with which it may be found acceptable, preferably the smaller speed craft, of which I indicate A as an example, having stern board A¹. The motor is supported on the rear of board A¹ by means of the arms B provided with clamps 73 that screw against the inside of stern A¹, said arms B being bent over stern A¹ and being formed with a frame B¹ that binds against the outside of stern A¹, see Figures 1 and 2. In this clamping frame is a horizontal pin 74 that serves as a journal on which is hung the eye C¹ of a ring D that encircles casing 46 within a horizontal outer groove 83, so that said casing 46 and the entire motor unit may be rotated horizontally within ring D, while also the motor unit may be deflected backward or forward from the perpendicular by moving it on journal 74 as a pivot, it being noted that the eye C¹ has ears that are bolted adjustably together by bolt 75 so as to tighten member C¹ or loosen it on journal 74.

It must also be noted that the arms B and frame B¹ are integral with sleeves C, C, in which the pin 74 is carried, and the movable or adjustable eye bearing C¹ on ring D surrounds pin 74 between sleeves C, C. Further the ring D is adjustable on casing 46 and has ears and bolts 91 so it may be loosened or tightened.

The stationary clamping frame B, B¹, that operates astride the stern, has the lower end provided with a rearwardly projecting horizontally curved arm E, or pair of parallel arms E, E, whose inner ends are secured to frame B¹ by bolts 82, 82. The arms E, E, extend on opposite sides of housing tube 57, see Figures 1 and 4. They are each provided with a series of perforations 87, those in one arm being opposite to those in the other, and a fastening pin 81 passes through any two opposite perforations and a perforation in an intermediate block 80 that carries a pin 79, the latter being a short pin that projects downwardly. I am now describing the means for reversely operating the propeller, as said means appears in Figures 1, 2, 3, and 4. An alternative means is shown in Figures 7, 8, and 9.

Further referring to Figures 1–4, it will be seen that the tube 57 is provided with an integral horizontal disc 76 located a short distance below arms E, E. The block 80 functions as a thrust block against which the propeller frame 57 thrusts itself as the screw 65 drives the boat ahead. And said block 80 has its pin 79 bearing against the semicircular shoulder 78 on disc 76 when the drive is a forward one, as shown in these figures. The disc 76 has a semicircular groove 77 that lies in the same circle as the shoulder 78, and groove 77 is engaged by the pin 79 when the motor is reversed for backing.

The handle 27 may be termed the steering handle, as it is commonly used for that purpose, while the pair of fixed handles 36 at the top of the motor are used for reversing the motor. In Figure 1 the motor is carried hung at the stern of the boat with all the parts in the proper position so that when the engine is operating it will drive the propeller so as to propel the boat ahead. To this end the proper adjustments have first been made. The clamping frame is clamped to the stern, with the arms E projecting rearwardly, and the thrust block 80 is held in the proper position by pin 81 passing through coincident holes so that the shaft housing 57 may have the desired perpendicularity and may bear against block 80, while the pin 79 sustains the thrust of the disc shoulder 78 against it. The shoulder 78 has enough arc length to allow of as much movement as ordinary turning in steering may require. The perpendicu-

larity of the motor is varied in the adjustment by swinging it on the pin 74 by manipulating eye piece C^1 on said pin, said eye piece being a part of ring D. The swinging of the motor in a vertical plane localizes it with reference to the bearing members 80, 79, and 78. In steering the handle 27 turns the motor in a horizontal plane by causing ring D to rotate more or less in groove 83.

Now we will next see what happens in changing the position of the various parts in reversing. The operator lays hold of handle 36 and gives the motor a turn of one-half of a circle, so as to bring the propeller from the rear position in Figure 1 to the front position in Figure 7, in which latter position it is qualified to drive the boat astern. In turning the device around the pin 79 slips from shoulder 78 into the groove 77 of disc 76, so that the thrust of the propeller, being opposite to what it is in Figure 1, the strain of its pull will come on the pin in the slot, for the tubular housing 57 is now being urged away from the block 80, as the propeller draws the boat A back, instead of against it as when the propeller is driving forwardly.

While the disc and pin device will serve effectively, I offer in Figures 7, 8, and 9, a substitute device, which has many meritorious features and may be employed with great advantage in many places. In this specimen the propeller, its frame, the rudder, the boat, the clamping frame, having rear arms E, and many other parts are the same as in the other specimen, but there are numerous different parts. Thus, instead of pin-provided block 80 I use a block 80^a which has no pin. This block 80^a sustains the propeller thrust and enables the motor to maintain its perpendicularity at a suitable distance from the stern in propelling forward, but when the propeller is reversed, the block 80^a for the time being has no function.

The casings 3 and 46 in this type of motor are the same as before, casing 3 having flange 93 and casing 46 having flange 94, these flanges being bolted together by bolts 47. One or the other of the flanges may however be somewhat modified, as for instance the flange 94 is made half size, and in place of the other half a large semicircular plate 92 is substituted and firmly held bolted to flange 93. This horizontal plate normally occupies the position shown in Figure 8, but it is large enough to reach over and above the clamping frame when the motor is rotated into the reversing position, see Figure 7. The function of plate 92 in this position is to rest on lugs 96 projecting from collars 95 which have lugs bolted together by bolts 98, and which collars are clamped tightly on the ends of a tubular journal pin 74^a that I substitute for the solid pin 74 of the other form of the invention. These collars can be adjusted so as to bring their lugs 96 to exactly the right level before tightening the bolts 98. Then if the motor be reversed and plate 92 brought directly above lugs 96, the action of the reversed propeller will not disturb the perpendicular position of the motor, for the strain will be taken by plate 92 against lugs 96, for the vertical propeller shafts will be locked as it were between block 80^a and lugs 96, see Figure 7. This locking position of plate 92 is also shown in dotted lines in Figure 8.

Thus the function and reliable character of my outboard motor are readily apparent. It is easily attached to or detached from any kind of water-craft; it is steered with accuracy and despatch; it is reversed neatly and surely so that the propeller operates to drive it in either direction as desired; it adjusts in a vertical or a horizontal plane, so as to cause it to overhang at the proper angle, and to reverse in the right direction; and especially the combination with the motive power of suitable fans to secure a perfectly air cooled motor in a marine engine, are all important features on which I base a fundamental claim.

What I claim is:

In a device of the class described, the combination of a vertical outboard motor including a frame member having an encircling groove, a ring in said groove so that the grooved member may be rotated in the ring, said ring having a perforated projection, a clamping frame secured on the stern of a boat and having an upper bearing, a journal in said bearing and perforated projection, on which journal the motor may be adjusted with reference to its perpendicularity and horizontal distance and angle from the stern, and an outwardly extending means from the lower rear part of the clamping frame having arms on opposite sides of the motor construction, a block in said arms having a pin, and a disc on the motor construction with a groove therein engaged by the pin at one time and a shoulder engaged by the pin at another time accordingly as the grooved motor frame member is rotated in the aforesaid ring.

In testimony whereof I hereunto affix my signature.

JOHN V. RICE, Jr.

May 19, 1931. H. RABEZZANA 1,806,548

SHIELDING MEANS FOR IGNITION APPARATUS

Filed Dec. 16, 1929

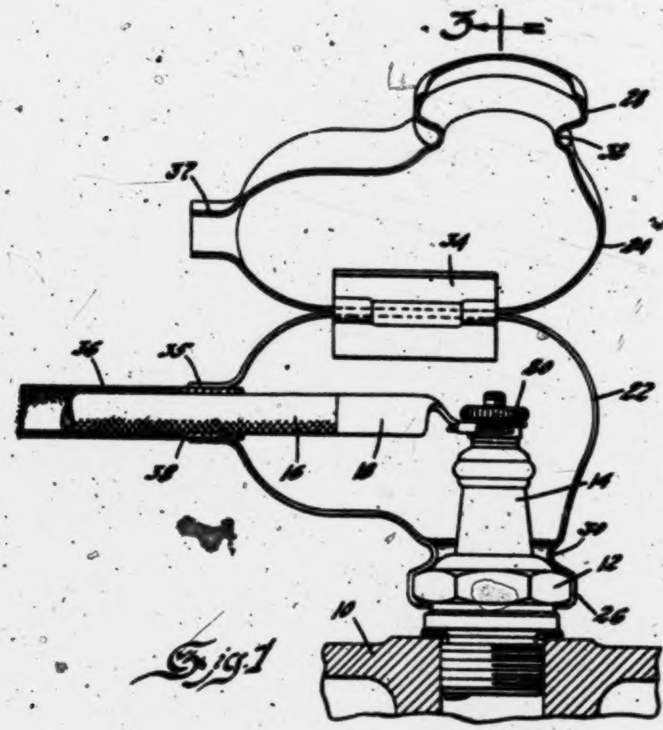


Fig. 1

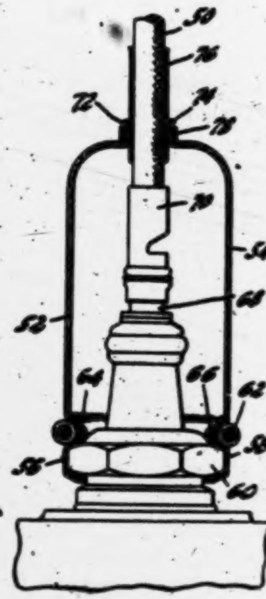


Fig. 5

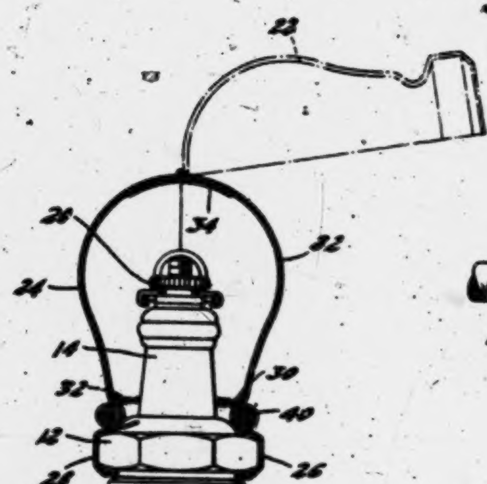


Fig. 3

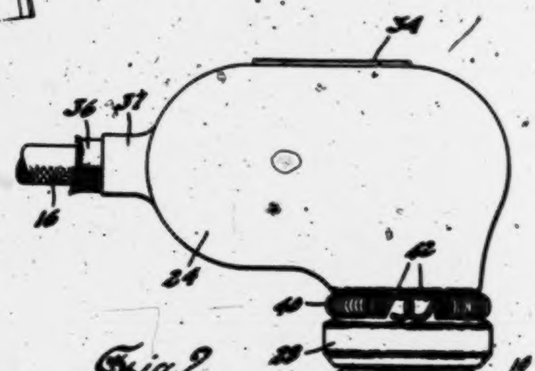


Fig. 2

Fig. 4

Inventor

Hector Rabezzana

By Blackmore, Spencer & Flint

Attorney

Patented May 19, 1931 **1,806,548**

565

UNITED STATES PATENT OFFICE

HECTOR RABEZZANA, OF FLINT, MICHIGAN, ASSIGNOR TO A C SPARK PLUG COMPANY, OF FLINT, MICHIGAN, A COMPANY OF MICHIGAN

SHIELDING MEANS FOR IGNITION APPARATUS

Application filed December 16, 1929. Serial No. 414,445.

This invention relates to shielding means for ignition apparatus, and more particularly to means for preventing the radiation of high frequency electrical energy from the spark plugs and the conductors leading thereto from the distributor. With the rapid increase in the use of radio apparatus on motor vehicles and aircraft, it is very desirable that the ignition mechanism be properly shielded in order to prevent the radiation of electrical energy which would otherwise tend to interfere with the operation of the radio equipment.

It is, therefore, an object of this invention to provide shielding means for the spark plugs and the ignition cable connected thereto, which will be simple in construction, and which will require no changes in the shape or construction of the spark plug or the cable, and is so devised that the terminal of the spark plug may be rendered accessible in order to connect or disconnect the cable therefrom.

Other objects and advantages will be apparent upon referring to the specification and accompanying drawings, in which:

Figure 1 is a fragmentary vertical section through the spark plug opening of an internal combustion engine, showing my improved shielding means associated with the spark plug and its conductor, with one-half of the casing shown swung up to permit the attachment of the conductor to the spark plug.

Figure 2 is a view corresponding somewhat to Figure 1 but showing the casing in closed position.

Figure 3 is a section taken on the line 3—3 of Figure 1.

Figure 4 is a fragmentary perspective view showing the hinge construction for pivotally connecting the two parts of the casing together.

Figure 5 is a view corresponding to Figure 1 but showing modified form of casing.

The reference numeral 10 indicates a portion of an internal combustion engine into which is threaded a conventional type of spark plug comprised of a metal shell 12 and an insulator member 14. An insulated conductor 16 leads from the distributor (not shown) to the spark plug and is connected to the latter by means of a connector 18 which is secured to the spark plug terminal 20 in any suitable manner.

In order to prevent the radiation of the high frequency electrical energy passing through the conductor 16 and the spark plug, I have constructed a metal casing formed of two stamping members 22 and 24 which are identical in shape. The lower portions 26 and 28 of each of these stampings are formed to a shape which will permit them to fit around that portion of the shell 12 which is adapted to be engaged by a wrench, and just above this portion grooves 30 and 32 are formed. The stampings 22 and 24 are pivotally connected to each other at their upper ends in any suitable manner such as by means of a hinge member 34. The opposite ends of the stampings 35 and 37 are formed to a comparatively small diameter in order to fit firmly against a metallic sheath 36 which surrounds the conductor 16 and which may or may not be provided with a ferrule 38, secured to the end of the sheath for the purpose of providing better electrical contact between the latter and the stampings 22 and 24. The opposite end of the sheath 36 is preferably connected to a metallic shield which encases the distributor mechanism and which is grounded to the engine.

In Figure 1, the casing is shown in open position, in order to permit the attachment of the connector 18 to the terminal 20. After this attachment has been made, the stamping 24 is swung down into position in contact with the spark plug shell 12 and is held in this position by means of a tension spring 40 which fits into the grooves 30 and 32. It will be readily seen that the action of this spring will serve not only to hold the two parts of the casing tightly against the shell but will also serve to force them into contact with the metallic sheath 36 or the ferrule 38 in case the latter is provided. The spring 40 may be of the endless type or may have hooks 42 formed on each end which may be interengaged after the spring has been placed in position in the grooves 30 and 32.

It will be readily seen that since the stamp-

ings 22 and 24 are pressed into contact with the spark plug shell 12, which in turn is grounded to the engine, and also into engagement with the metallic sheath 36, that it will be impossible for any radiation of electrical energy to occur since such radiation will be intercepted by the stampings 22 and 24 and will be grounded by being conducted into the engine and thence into the chassis frame.

In Figure 5 is shown a slightly different type of casing designed for use in connection with an installation wherein the conductor 50 approaches the spark plug from a vertical position. In this form, the casing is composed of two semi-circular stampings 52 and 54, the lower ends 56 and 58 of which are shaped to fit over the spark plug shell 60, and a coil spring 62 fits into depressions 64 and 66 formed in the stampings and serves to hold the latter in intimate engagement with the shell 60. The conductor 50 is connected to the spark plug terminal 68 by means of a connector 70. The upper ends 72 and 74 of the stampings 52 and 54 are reduced in diameter and are held in close contact with a metallic sheath 76 which surrounds the conductor 50, by means of a ring 78 which may be welded or otherwise secured to the stamping 52. In assembling this casing in position, the stamping 52 is placed in position against the spark plug shell and the conductor 50 is passed through the ring 78 and connected to the terminal 68. The portion 74 of the stamping 54 is then slipped in place under the ring 78 and the lower end 58 is placed against the spark plug shell 60. The coil spring 62 is then slipped over the ends of the stampings 52 and 54 into the grooves 64 and 66, thereby holding the lower ends of the stampings against the shell 60 and the upper ends against the metallic sheath 76. Obviously the ring 78 may be dispensed with and the hinge construction shown in Figure 1 may be used if desired.

It will thus be seen that I have provided a shielding means which may be very cheaply produced since it is principally composed of stampings, and which will require no changes in shape or construction of either the spark plug or the conductor. Thus it may be used in connection with the conventional types of spark plugs and conductors, and consequently may be readily fitted to engines now in use. By constructing the casing in two parts which are movable relative to each other, it may be readily opened in order to permit the attachment to or removal from the spark plug of the conductor, or to permit inspection of the upper end of the spark plug.

It is thought from the foregoing, taken in connection with the accompanying drawings, that the construction and operation of the device will be apparent to those skilled in the art, and that various changes in size, shape, and proportion and details of construction may be made without departing from the spirit and scope of the appended claims.

I claim:

1. A device for shielding a spark plug to prevent the radiation of electrical energy therefrom comprising a casing formed of complementary sections, and means for pivotally connecting said sections to each other.

2. A device for shielding a spark plug to prevent the radiation of electrical energy therefrom comprising a casing formed of complementary sections, and resilient means adapted to hold said sections in contact with each other.

3. A device for shielding a spark plug to prevent the radiation of electrical energy therefrom comprising a casing formed of complementary sections, and means adapted to hold said sections in contact with each other and in position upon the spark plug.

4. A device for shielding a spark plug to prevent the radiation of electrical energy therefrom comprising a casing formed of complementary sections, means for pivotally connecting said sections to each other, and means adapted to hold said sections in closed position in contact with each other.

5. A device for shielding a spark plug to prevent the radiation of electrical energy therefrom comprising a casing formed of complementary sections, means pivotally connecting said sections to each other, and means adapted to hold said sections in contact with each other and in position upon the spark plug.

6. In combination with a spark plug including a metal shell, and a shielded conductor therefor, a device for preventing radiation of electrical energy therefrom comprising a casing formed of complementary sections, and means adapted to hold said sections in contact with each other and in contact with the shell and the shielded conductor.

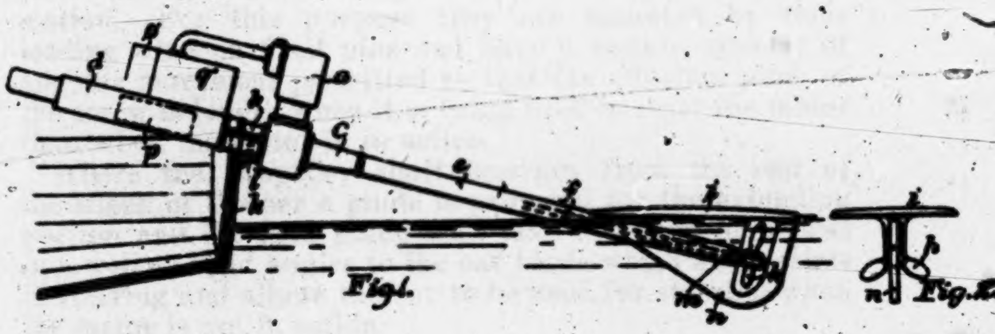
In testimony whereof I affix my signature.

HECTOR RABEZZANA.

A.D. 1902. July 2. N° 14,792.

LANCHESTER'S Complete Specification.

1 SHEET.



[This Drawing is a reproduction of the Original on a reduced scale]

Malby & Sons, Photo-Litho.

614 No. 14,792.—A. D. 1902.

Lanchester's Improvements in Mechanism for the Propulsion of Boats.

take the thrust of propulsion and when the oar is in use it may be laid at any desired angle for the purpose of steering the boat.

If desired the oar may be temporarily removed from the rowlock and employed in any other direction as for turning the boat in its own length, or reversing, &c.

In order to start the motor the oar may be dragged briskly through the water, the reaction on the blades of of the screw propeller being sufficient to set it going. A certain amount of swivel motion may be allowed to the propeller blades to assist them in better setting the engine in motion. For this purpose they are mounted by their leading edge on fixed pins and have a certain amount of angular movement permitted so that the effective pitch of the screw is longer when it is being used to start the motor than when the motor is in action.

Where the propeller shaft emerges from the end of the shank of the oar a guide is provided for the extending portion and the said guide may take the form of a boss in a web at right angles to the oar blade which also assists in steering and allows the oar to be used for steering when the motor is not in action.

Water cooling of the motor cylinder may be provided for by a flow and return pipe from the immersed portion of the oar, the aperture of the flow pipe being bent round to face the direction of motion and preferably to receive water from the propeller race. When the circulating pipe is charged it acts to a certain extent as a syphon so that there is little or no head of water to be overcome. In order to start circulation the handle of the oar may be lowered to near the water level. The return pipe may be allowed to discharge above the water level if preferred so that the circulation is visible.

Dated this 2nd day of July, 1902.

Marks & Clerk
18, Southampton Buildings, London, W.C.
13, Temple Street, Birmingham, and
30, Cross Street Manchester. Agents.

Complete Specification.

"Improvements in Mechanism for the Propulsion of Boats."

I, Frederick William Lanchester, Eningeer, of 53, Hagley Road, Edgbaston, Birmingham, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to improvements in mechanism for the propulsion of boats and refers more particularly to an improved appliance for the propulsion of boats of small dimensions or for use as an auxiliary means of propulsion for sailing boats and larger craft.

The invention has for its object to provide a self-contained propelling apparatus of a convenient and portable form which may be applied to the propulsion of any boat or vessel and transferred from one vessel to another with little or no preparation.

The invention consists in brief in the application of a self-contained motor and screw propeller to an oar or scull of special construction, the propeller shaft being arranged longitudinally and the motor with its appurtenances built into the handle portion of the oar, an oar blade protecting the screw propeller and regulating its immersion.

Referring to the accompanying drawings,

Figure 1 is a side view and

615 Figure 2 an end view of one form of the apparatus.

In carrying my invention into effect as shown in the accompanying drawings, I employ a high speed oil motor *a* of small dimensions, having tubular extensions *b, c,* on the crank chamber co-axial with the crank shaft. Into one of these extensions *b* the handle portion *d* of an oar is fixed, while the blade portion *e* of the oar is fixed into the other extension *c*. The blade portion *e* is bored its entire length to accommodate the propeller shaft *f,* one end of which is coupled to the crankshaft of the motor *a,* while the other end carries a screw propeller *h*. The blade *i* of the oar is bent to one side as shown to clear the propeller, the angle at which it is set being such as will allow it to lie approximately flat on the water when the oar is in position.

The handle portion *d* of the oar may conveniently be made hollow and may contain the coil *p* for the purposes

of ignition. The oil reservoir q and battery o may also be accommodated in the handle portion or in a special saddle shaped tank suitably fitted. The thrust of the screw is longitudinal to the oar, which projects over the stern k of the boat which is being propelled.

Small sea-boat are uually arranged with a rudimentary row-lock for the purpose of propulsion with a single oar, the said row-lock usually taking the form of a semi-circular bite in the transom. I preferably arrange to make use of such row-lock and the oar is arranged to drop into the said bite having a plate which rests on the top of the transom to prevent the oar from rotating axially. A suitable projection l is also provided on the underside of the oar to take the thrust of propulsion, and when the oar is in use it may be laid at any desired angle for the purpose of steering the boat.

If desired the oar may be removed from the row-lock and employed in any other direction as for turning the boat in its own length, reversing, etc.,

In order to start the motor the oar may be dragged briskly through the water the reaction being sufficient to start it. A certain amount of swivel motion may be allowed to the propeller blades to assist them in starting the engine. For this purpose the blades are mounted by their leading edge on fixed pins and have a certain amount of angular movement permitted so that the effective pitch of the screw is greater when it is being used to start the motor than when it is propelling the vessel.

Where the propeller shaft emerges from the end of the shank of the oar a guide m is provided for the projecting portion of the shaft consisting of a boss in a web n at right angles to the blade i. This web n also assists in steering and allows the oar to be used for steering when the motor is not in action.

Water cooling of the motor cylinder may be provided for by a flow and return pipe from the immersed portion of the oar the aperture of the flow pipe being bent round to face the direction of motion and preferably to receive water from the propeller race. When the circulating pipe is charged it acts to a certain extent as a syphon so that there is little or no head of water to be overcome. In order to start circulation the handle of the oar may be lowered to near the water level. The return pipe may be allowed to discharge above the water level if preferred so that the circulation is visible.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed I declare that what I claim is:—

1. An apparatus for propelling a vessel consisting of a portable oar or scull containing a motor and a screw propeller connected to the motor and adapted to be driven by it, the whole being combined in one apparatus, substantially as described.

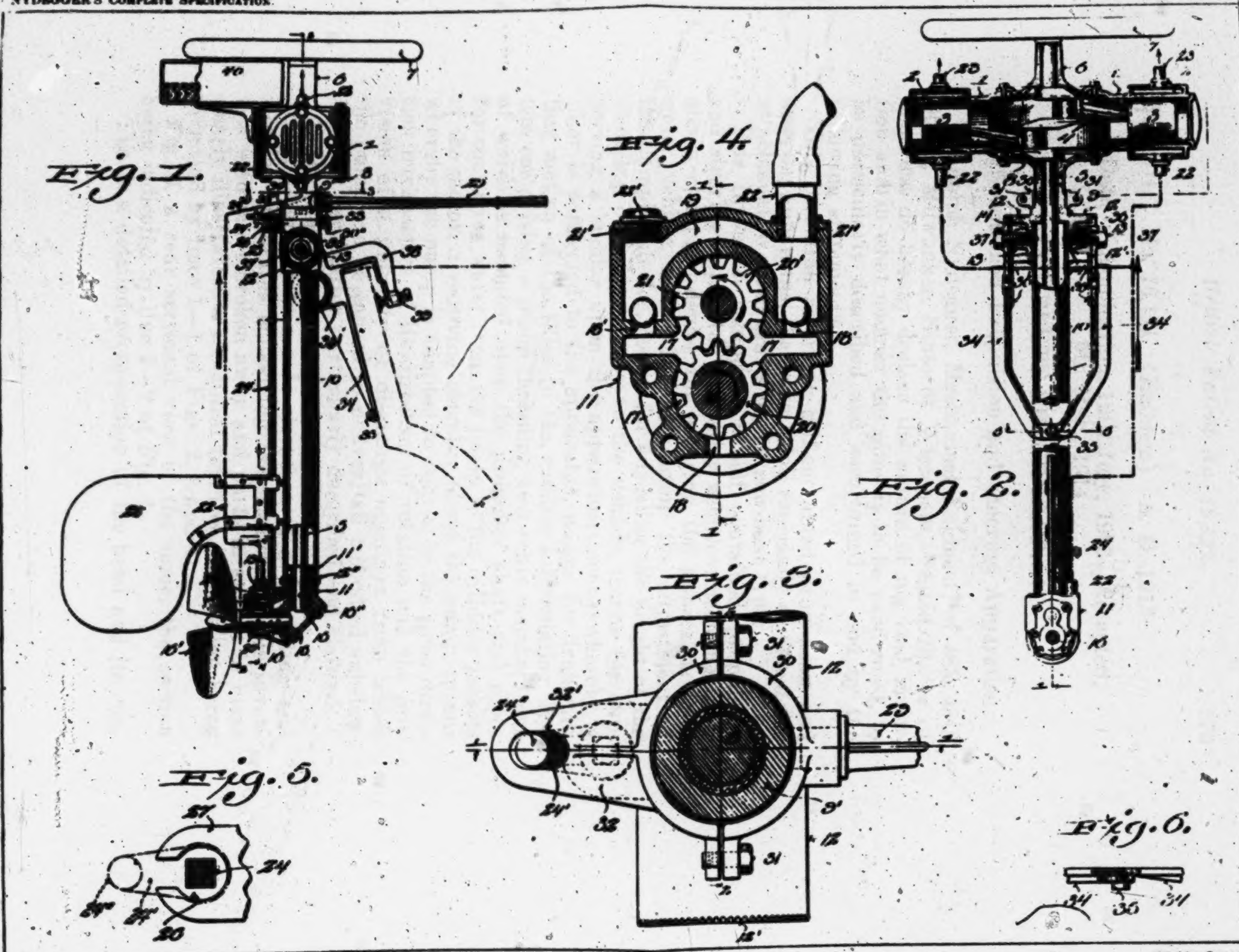
2. An apparatus for propelling a vessel, consisting of a motor from the casing of which extensions extend coaxial with the motor shaft, which rotates in one of these extensions and carries a propeller at its free end, the apparatus being adapted to be readily transferred from one vessel to another, substantially as described.

616 3. The propelling apparatus hereinbefore described with reference to the accompanying drawings.

Dated this 2nd day of May, 1903.

Marks & Clerk,
18, Southampton Buildings, London, W. C.,
13, Temple Street, Birmingham, and
30, Cross Street Manchester,
Agents.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1903.



Malby & Sons Photo-Litho

618 No. 16,121 (Emblem) A. D. 1913

Date of Application, 12th July, 1913—Accepted, 5th Mar., 1914

COMPLETE SPECIFICATION.

Self-contained Propulsion and Steering Apparatus.

I, Adolph Nydegger, Mechanical Engineer, of 485, 48th Street, Milwaukee, State of Wisconsin, United States of America, do hereby declare the nature of my said invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention refers to self-contained propulsion and steering apparatus, the same being especially designed for attachment to small crafts of the row-boat type.

This invention comprises a self contained propulsion and steering apparatus for water vehicles including inter alia a clamping device for securing the apparatus to a water vehicle, means for facilitating the adjustment of the clamping device, means for adjusting the height of the clamping device relatively to the vehicle, means for supporting a rudder upon the apparatus, means whereby a tiller is connected to the apparatus, means for transmitting motion of the tiller to the rudder, a circulating system comprising a pump including two rotor members one of which is mounted upon the propeller shaft and pipes for conveying water from the pump to the cylinder jackets of the motor, a receiving chamber above the pump, means whereby the pump is adapted to deliver in the same direction irrespective of its direction of rotation and the provision of a plurality of discharge openings from which the pump can be caused to deliver, all embodied substantially as hereinafter particularly described and claimed.

In the drawings

Fig. 1 represents a side elevation of a propelling and steering apparatus embodying the features of this invention with parts broken away and parts in section to more clearly illustrate the structural features, the section being indicated by lines 1—1 of Figs. 2, 3 and 4;

Fig. 2, a rear sectional view of the same, the section being indicated by line 2—2 of Fig. 1;

Fig. 3, a detailed cross-section of the head and its con-

nected steering mechanism, the view being upon an enlarged scale and the section indicated by line 3—3 of Fig. 1;

Fig. 4, an enlarged sectional face view of the pump mechanism, the section being indicated by line 4—4 of Fig. 1;

Fig. 5, a detailed sectional view of a rudder stem showing a key-hole slotted ear that extends from the head, into which ear the upper end of said stem is journaled, and

Fig. 6, a detailed cross-section of a two part clamping-bracket showing a hinge connection between its members.

Referring by characters to the drawings, 1, 1 represent the cylinders comprising part of an engine-shell provided with the usual water-jackets 2. Mounted in the cylinders are pistons 3 having pitmans 4, which are connected to cranks of an engine-shaft 5. The upper end of the engine-shaft is journaled in a cap 6 that is detachably fitted to an aperture in the crank-casing which forms part of the engine-shell, the said shaft being provided with the usual fly-wheel 7. Fitted to a lower opening in the crank-casing is the flanged portion 8 of a head 9, which head serves
619 as a support for the engine-shell and is bored to also form a bearing for the engine-shaft. The lower end of the head is counter-bored for the reception of one end of a sleeve 10. The lower end of the sleeve has detachably secured thereto a gear-casing 11, the same being held in position by screws 12^{11}, which pass through apertures in the shell and are in threaded union with corresponding apertures in a shank 11^1 forming part of the casing, the same propjecting into the mouth of the sleeve.

The lower portion of the head 9 has extending therefrom in opposite directions, a pair of hollow hubs 12, the faces of which are provided with radially disposed clutch-teeth 12^1 the said hubs constituting clutch members. Each of the hubs is provided with a centrally disposed apertured nipple 13, which apertures are threaded throughout their length and are adapted to receive corresponding threaded plugs 14, which plugs have tapered ends that enter apertures in the sleeve 10, whereby the latter is rigidly secured with relation to said head. Referring again to the gear housing attached at the free end of the sleeve, the shank 11^1 of said housing is bored to form a bearing for the lower end of the engine-shaft which projects through said shank and carries a miter-gear 15 that meshes with a corresponding miter-gear 15^1. The

latter gear is secured to a horizontally disposed arbor 16 that is journaled in bearing with which the gear-casing is provided, the said arbor being extended beyond the casing and carries the usual propeller-wheel 16^1.

As best shown in Figs. 1 and 4 of drawings the arbor 16 passes through a pump chamber 17 that is formed in the gear casing. This chamber is provided with an intake port 18 and a pair of valve-controlled discharge ports 18^1, which ports communicate with a common receiving chamber 19. Secured to the arbor 16 and within the pump chamber 17 is a toothed rotor 20, which meshes with a corresponding toothed rotor 20^1 that is revolubly mounted upon a stud 21, the ends of the same being journaled in recesses with which the walls of the pump chamber are provided. The receiving chamber is provided with a pair of threaded discharge apertures 21^1, one of which is fitted with the usual water-supply pipe 22, the other being blind and is closed by a plug 22^1. It is apparent that either one of the discharge apertures may be utilized for the pipe connection at the convenience of the manufacturer.

I am aware that, in connection with combined propulsion and steering devices, it has previously been proposed to drive a circulating pump from the propeller shaft; therefore I lay no claim broadly thereto.

The discharge pipe 22, as indicated by dotted lines in Figs. 1 and 2, is provided with branch connections that communicate with the cylinder water-jackets 2, 2^1, the water being exhausted through discharge pipe 23 that communicate with the jacket, whereby the cooling is effected, it being understood that this circulating system forms no part of this invention, except so far as the peculiar arrangement of the pump. By this arrangement it is apparent that a continuous flow of water is discharged into the receiving chamber irrespective of the direction of rotation of the propeller arbor, due to the check-valve controlled discharge apertures 18^1, 18^1, which are disposed upon opposite sides of the rotors, whereby the water is delivered from the pump chamber. For example, should the arbor be rotated in the direction as indicated by the arrow in Fig. 4, it is apparent that the discharge of water will be through the left-hand valve-controlled discharge port, while the pressure in the chamber 19 against the right-hand check-valve mechanism will prevent back-flow.

The lower end of a rudder-stem 24 is stepped into the gear-casing 11, and the upper end of said stem carries a

crank 24^{1} having an upwardly extending crank-pin 24^{11}, and a depending circular hub 25. As best shown in Figs. 1 and 5, the upper end of the rudder-stem is journaled by engagement of the crank-hub 25 with the circular portion 26 of a key-hole slot, which slot is formed in an ear 27 that extends from the engine-shell supporting head 9.

This key-hole slot connection is formed for the purpose of convenience in assemblage, which assemblage is effected by first fitting the rudder-stem, which protrudes from the crank-hub, through the throat of the key-hole slot and thereafter said stem is dropped into position, whereby the hub is seated within the circular portion of said slot and, simultaneously, the lower end of the aforesaid stem enters the recess in the gear-housing that forms the stepped bearing for said stem. A rudder-blade 28 is suitably secured to the stem 24, being flared downwardly about the propeller-wheel to permit clearance, whereby the rudder is capable of the desired swing, said rudder in its form also constituting a guard for the propeller. The rudder-stem is actuated by a tiller 29 which is secured to one member 30 of a two-part clip that is loosely mounted upon a neck portion 9^{1} of the head, the opposite member 30^{1} of the two-part clip being secured by suitable bolts 31 which engage ears that extend from said members. The clip-member 30^{1} has extending rearwardly therefrom a finger 32, the end of which is provided with a slot 32^{1} for engagement with the crank-pin 24^{11}. In order to prevent longitudinal displacement of the tiller-clip, the member 30 thereof has depending therefrom an ear 30^{11}, which ear carries a screw that extends under a web 33 that constitutes a part of the head, the web being of such width as to permit ordinary oscillatory play of the tiller without disengagement of the locking screw.

The entire propelling and steering apparatus is suspended from the craft to which it is attached, by means of a two-part clamping bracket, which bracket is formed by a pair of arms 34, the same being hinged together at their lower ends and secured by a bolt 35. The upper ends of the bracket arms as shown, are provided with corresponding sets of toothed clutch-disks 36, 36^{1}, which disks project inwardly and are formed with radial teeth corresponding to the radial clutch-teeth of the clutch-hubs 12. Each pair of the clutch-disks are centrally apertured and are positioned upon different horizontal planes, whereby they may selectively be fitted to the hub-members 12

in order to regulate the position of the propeller-wheel with relation to the draft of the craft to which the apparatus is attached. After the selected elevation of the apparatus has been determined the companion pair of toothed disks are aligned with the hubs and the bracket-arms are then contracted by swing, upon their pivot, whereby a clutching-engagement is effected between the disks and toothed hubs. The interlocked clutch-members are then secured by clamping-bolts 37, which bolts pass through the disk apertures and effect threaded engagement with the threaded apertures of the nipples 13, whereby the arms are drawn tightly together and thus the head and its connected mechanism is securely locked in pivotal union with the bracket. It is apparent that by loosening the clamping bolts 37 the apparatus may be swung upon its pivot so as to adjust the sleeve and its connected propeller at any desired angle. The bracket arms are also provided with forwardly extending rectangular legs 38 which are fitted over the gunwale of the boat, the said bracket being secured by clamping screws 39 that engage the inner wall of the boat, which clamping screws are carried by the leg.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:—

1. A self-contained propulsion and steering apparatus for water vehicles including a motor, a propeller driven by said motor and a clamping device for securing the apparatus to the vehicle, said clamping device having oppositely directed clutch members adapted to co-act with clutch members on the motor for connecting the clamping device adjustably with the apparatus.

2. Self-contained propulsion and steering apparatus for water vehicles as set forth in Claim 1, including a head under the motor casing oppositely directed hubs projecting from said head, friction teeth on the outer surface of said hubs, a plurality of arms forming part of the clamping device, inwardly directed lugs on said arms provided
621 with friction teeth and means for securing said lugs centrally and adjustably to said hubs for connecting the clamping device with the motor.

3. Self-contained propulsion and steering apparatus for water vehicles, set forth in Claim 1 including a pivotal connection for the arms of the clamping device in order to facilitate the adjustment of the clamping apparatus to

the motor by means of the lugs and hubs forming parts of the arms and the motor casing respectively.

4. Self-contained propulsion and steering apparatus as set forth in Claim 1 including a plurality of lugs at various distances from the pivotal point of connection of the arms whereby the depth of the propeller shaft with respect to the depth of the vehicle may be regulated.

5. Self-contained propulsion and steering apparatus as set forth in Claim 1 including a rudder and a stem for the rudder, the stem being supported in the lug projecting from the head of the motor and being also supported in the gear-casing for the propeller.

6. Self-contained propulsion and steering apparatus for water vehicles as set forth in Claims 1 and 5 including a key-hole slot in the lug projecting from the head, the upper part of the rudder stem being introduced into said slot through the narrow part thereof and being supported in the circular part of the slot by means of the hub of the crank, said hub filling the circular part of the slot so as to center the stem of the rudder.

7. Self-contained propeller and steering apparatus as set forth in Claims 1 and 6 including a tiller and a two part clamp connected with said tiller and surrounding part of the motor casing, a portion of said tiller being connected with the crank on the rudder stem in order to render it possible that the rudder be actuated when the tiller is swinging about its axis.

8. Self-contained propulsion and steering apparatus for water vehicles as set forth in Claim 1 including a gear-casing for the propeller, a pump in said gear-casing, a receiving chamber into which the cooling fluid from the pump is conveyed and a pipe leading from the receiving chamber to the various cooling jackets of the cylinder.

9. Self-contained propulsion and steering apparatus as set forth in Claims 1 and 8 including a plurality of discharge openings on the receiving chamber, the pipe connection being adapted for adjustment to any of these discharge openings and means for closing the other openings to which the pipe connection is not attached.

10. Self-contained propulsion and steering apparatus as set forth in Claims 1 and 8 including a rotor member mounted on the propeller shaft, another rotor member driven by the first named member and mounted on the counter-shaft, said first named rotor member conveying the cooling fluid into pump chamber and said second rotor

member being adapted to convey the cooling fluid from the pump chamber into the receiving chamber substantially as described.

11. Self-contained propulsion and steering apparatus as set forth in Claims 1 and 8 including a plurality of discharge valves leading from the pump chamber into the receiving chamber, said valves being disposed on opposite sides of the secondary rotor in order to admit conveyance of the cooling fluid from the pump chamber into the receiving chamber independently of the direction of rotation of the propeller, substantially as described.

12. Self-contained propulsion and steering apparatus for water vehicles substantially as described and shown and for the purpose set forth.

Dated this 12th day of July, 1913.

A. A. Thornton,
38, Chancery Lane, London, W. C.,
Agent for the Applicant.

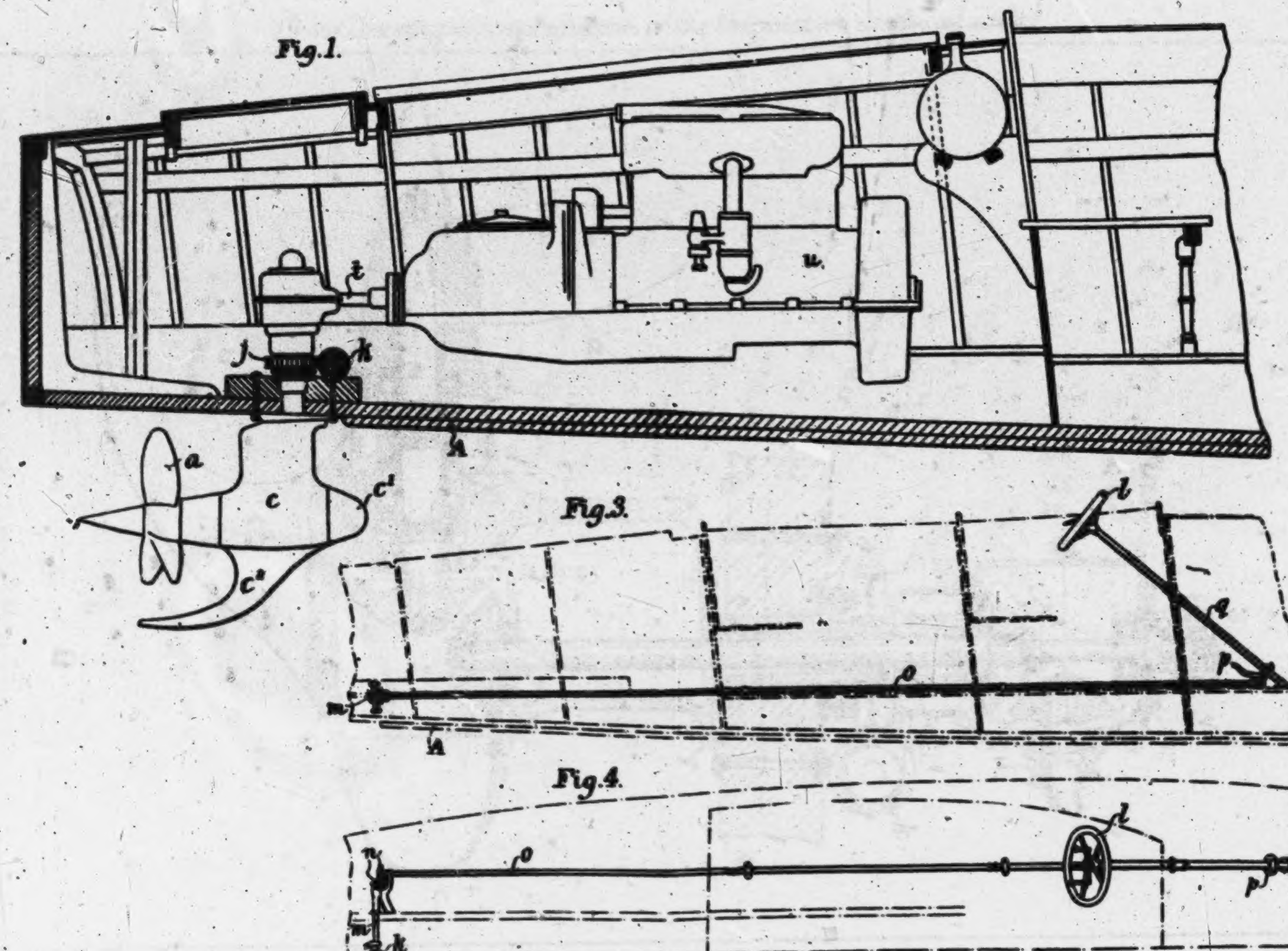
Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1914.

2 SHEETS
SHEET 1

Fig. 1.

Fig. 3.

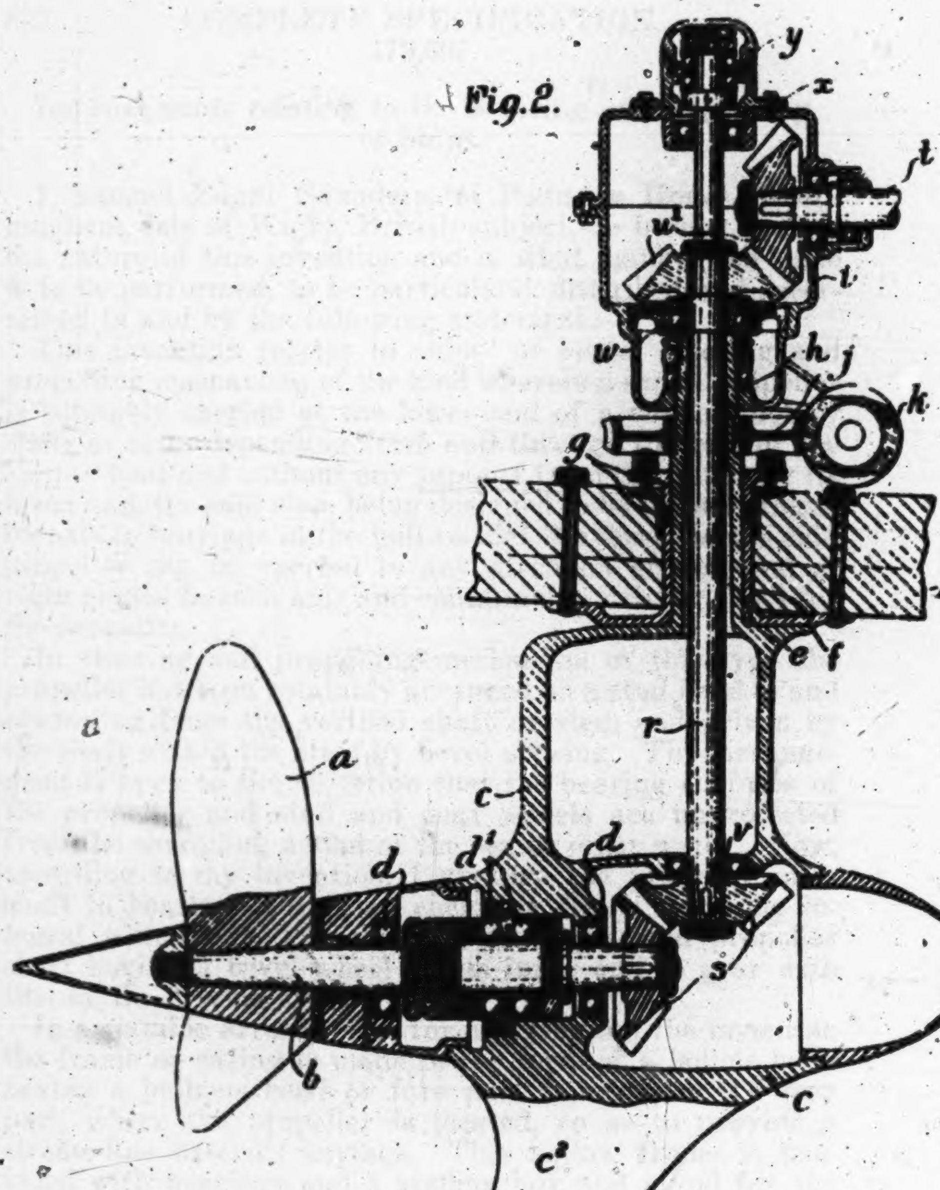
Fig. 4.



[This Drawing is a reproduction of the Original on a reduced scale]

[This Drawing is a reproduction of the Original on a reduced scale]

Fig.2.



625 COMPLETE SPECIFICATION.
179,607

Improvements relating to the Steering and Propelling of Ships.

I, Samuel Edgar Saunders, of Padmore House, Whippingham, Isle of Wight, British subject, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to ships' or boats' steering and propelling mechanism of the kind wherein a screw propeller is rotatably carried at the lower end of a vertical hollow shaft or stem depending from and through the hull of the ship or boat and without any support from the latter for its lower end, the said stem being designed to be turned around its axis in bearings in the hull so that the thrust of the said propeller can be exerted in any direction around and at right angles to such axis and containing a driving shaft for the propeller.

In steering and propelling mechanism of this type the propeller has been rotatably arranged on a stud fixed to and projecting from the vertical shaft or stem and driven by the shaft within the stem by bevel gearing. This arrangement is open to the objection that the bearing surfaces of the propeller and stud and gear wheels are unprotected from the corroding action of the sea or other water. Now, according to my invention, I arrange the propeller on a shaft in bearings within an enclosing frame or casing integral with the hollow shaft or stem, the said propeller shaft having a bevel wheel on its inner end to gear with that on the driving shaft.

In a suitable arrangement for carrying out the invention the frame or casing is made in the form of a hollow body having a bulbous head or fore part tapering to the rear part, where the propeller is located, so as to provide a stream-line exterior surface. This hollow frame is provided with bearings and a stuffing box and gland for the propeller shaft. The vertical hollow stem on the frame or casing is formed cylindrical and passes through a bearing in the hull of the ship, which bearing is provided with a stuffing box and gland, and its upper end is supported in a thrust bearing. Means such as a worm-wheel on the vertical stem actuated by a worm in connection with a steering

wheel enable the casing to be turned around the vertical axis of the stem so that the thrust of the propeller can be exerted in any direction around such axis for propulsive and steering purposes. Within the hollow vertical stem of the frame or casing is arranged a vertical driving shaft, the lower end of which turns in a bearing in the said frame and serves to drive the propeller shaft by bevel gearing, whilst its upper end, which is located in bearings, some of which are of the thrust type, is driven by means of bevel gearing from a horizontal shaft actuated by a suitable engine or motor. Or the vertical driving shaft can be driven directly by an engine of the radial type. The bearings are preferably of the ball type.

To enable the invention to be fully understood I will describe it by reference to the accompanying drawings, in which:—

Figure 1 is a sectional side view of the after part of a motor-boat provided with a screw-propeller arranged in accordance with the invention so that its thrust can be exerted in any direction around a vertical axis.

Figure 2 is a sectional side view to a larger scale of the propeller and its driving mechanism.

Figure 3 is a diagrammatic side view showing the mechanism for controlling the propeller for steering purposes and

Figure 4 is a half plan thereof.

a is the propeller and *b* the shaft carrying the same, *c* is the hollow frame or casing provided with supporting and thrust bearings d, d^1, respectively, for the said shaft and *e* is the hollow vertical stem on the said frame. This stem passes upwards through the bottom of the hull or keel of the boat, and is formed cylindrical so as to fit and turn within a bearing *f* secured within the hull A and having a stuffing-box and gland *g* to prevent entrance of water into the boat around the said stem. *h* is the thrust bearing supporting the said stem, the said bearing being arranged within a casing or frame *i* secured in any suitable manner in the interior of the boat.

626 c^1 is the bulbous fore part of the hollow frame *c* which tapers to the rear part where the propeller *a* is located, so as to provide a stream-line exterior surface. c^2 is a skeg on the casing *c*.

j is the worm-wheel on the stem *e* and *k* is the worm in mesh therewith, the said worm being in operative connection with a steering wheel *l* through the medium of a worm-

shaft *m*, bevel-wheels *n*, a shaft *o*, bevel-wheels *p* and a shaft *q* carrying the said steering wheel, as clearly indicated in Figures 3 and 4.

By manipulating the steering wheel *l* it will be seen that the frame *c* can be turned around the axis of the vertical stem *e* so that the thrust of the propeller *a* can be exerted in any direction around such axis, whereby the boat can not only be driven ahead by a thrust direct astern in the usual manner with screw propelled boats and the like, but can also be steered ahead by directing the propeller at an angle less than a right angle to the boat's centre line.

By turning the frame *c* through an angle of 180° from the position indicated in Figures 1 and 2, so that the thrust of the propeller is in a forward direction, the boat can be driven astern and also steered in this direction by turning the said frame so that the propeller is at an angle less than a right angle to the boat's centre line.

r is the vertical driving shaft passing through the hollow stem *e* and serving to actuate the propeller shaft by bevel wheels *s*, whilst *t* is the horizontal shaft of the engine or motor *u*, the power of which is transmitted by the said shaft to the shaft *r* by the bevel wheels u^1. The shaft *r* is located in supporting bearings *v, w, x* and a thrust bearing *y*, the bearing *v* being arranged in the casing *c* whilst the last mentioned three bearings are arranged in the frame *i*.

All the bearings are preferably of the ball type as indicated.

Instead of an engine of the type indicated provided with the horizontal shaft *t*, I may employ a radial engine to drive the vertical shaft *r* direct.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. Ships' and boats' steering and propelling mechanism of the kind hereinbefore referred to wherein the propeller is carried on a shaft in bearings within an enclosing frame or casing integral with the hollow shaft or stem, the said propeller shaft having a bevel wheel on its inner end to gear with that on the driving shaft, substantially as described.

2. Ships' and boats' steering and propelling mechanism as claimed in Claim 1, wherein the frame or casing carrying the propeller shaft is made in the form of a hollow body having a bulbous head or fore part tapering to the rear part where the propeller is located so as to provide a stream line exterior, substantially as described.

3. The improved mechanism for propelling and steering ships or boats, constructed, arranged and operating substantially as hereinbefore described and illustrated in the accompanying drawings.

Dated the 1st day of November, 1921.

G. F. Redfern & Co.,
15, South Street, Finsbury, E.C. 2,
Agents for the Applicant.

Reference has been directed, in pursuant of Section 7, Sub-section 4, of the Patents and Designs Acts, 1907 and 1919, to Specifications No. 2277 of 1874, No. 7839 of 1900, No. 10,935 of 1900, No. 17,748 of 1907, and No. 28,201 of 1911.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1922.

Fig.2

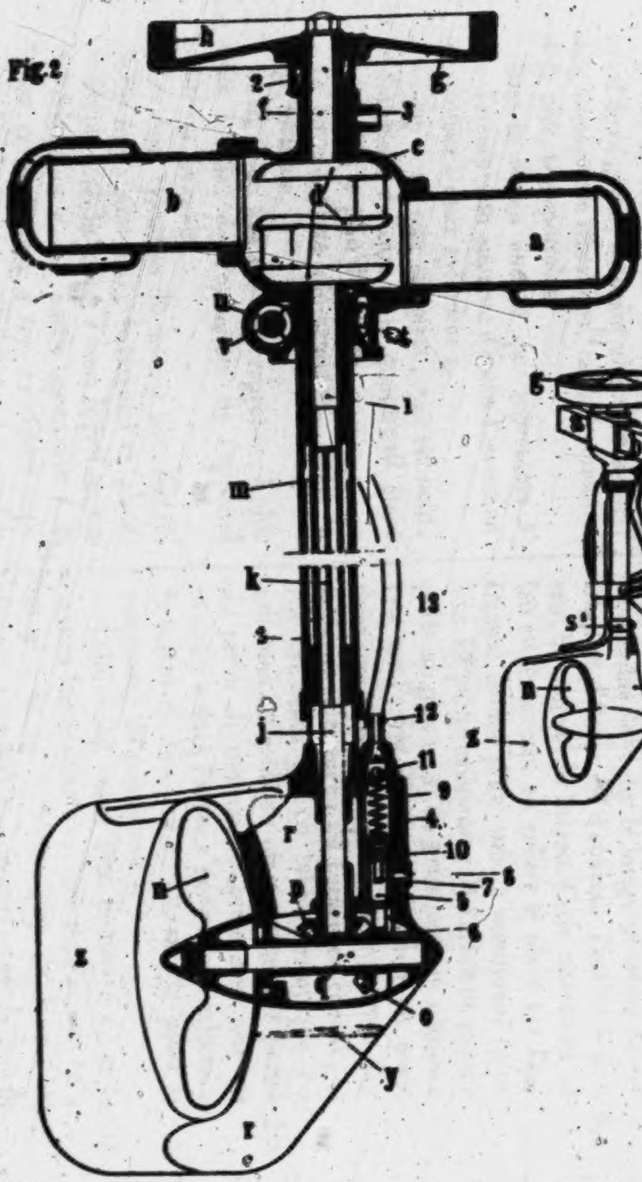
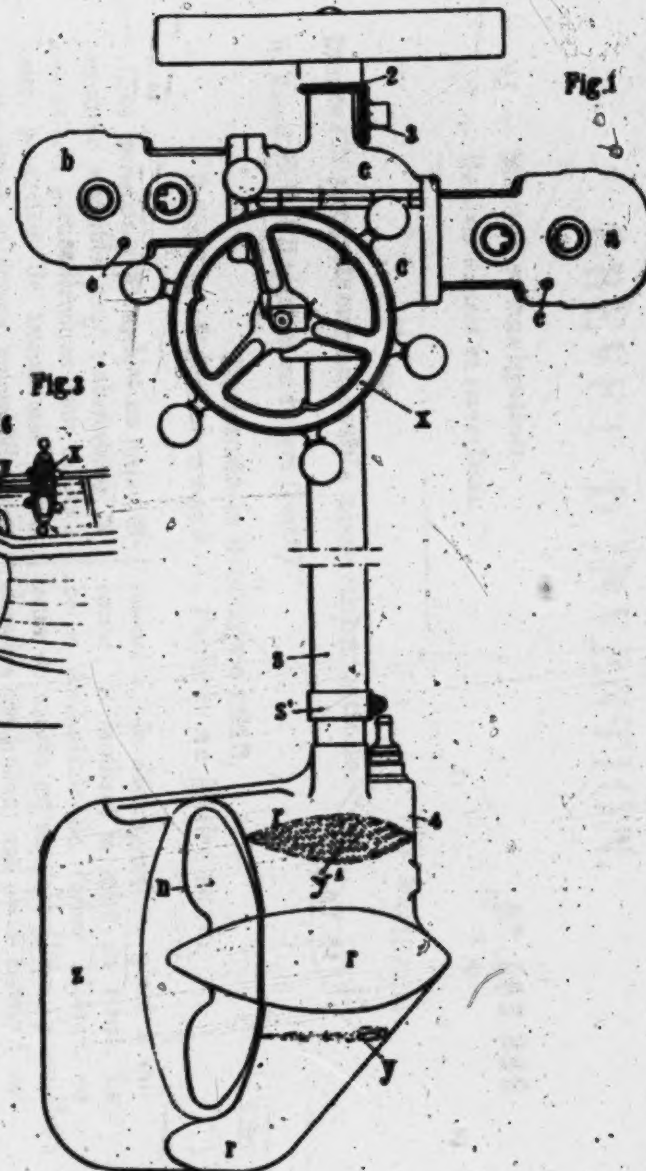


Fig.3

Fig.1



591

RÉPUBLIQUE FRANÇAISE.

OFFICE NATIONAL DE LA PROPRIÉTÉ INDUSTRIELLE.

BREVET D'INVENTION.

VI. — Marine et navigation.

2. — Machines marines et propulseurs.

N° 463.386

Dispositif propulseur amovible pour embarcations.

M. Marcel ECHARD résidant en France (Seine).

Demandé le 8 octobre 1913.

Délivré le 15 décembre 1913. — Publié le 20 février 1914.

Cette invention a pour objet un dispositif propulseur amovible pour embarcations de toute nature, particulièrement pour canots à rames, permettant de transformer ceux-ci instantanément en canots automobiles sans aucun changement.

Le but de l'invention est de créer un dispositif de ce genre, assurant une marche parfaite, exempte de vibrations, facile à conduire et de plus, transportable.

Dans le dessin annexé qui représente à titre d'exemple un appareil d'après l'invention avec moteur à deux cylindres :

La fig. 1 est une élévation, vue en bout, de l'intérieur du canot, le gouvernail étant rabattu dans le plan du dessin.

La fig. 2 est une vue semblable, mais en coupe verticale.

La fig. 3 est une vue en perspective, à plus petite échelle, de l'ensemble de l'appareil monté sur un canot.

Les deux cylindres du moteur sont figurés en *a* et *b*; ils sont à axe horizontal et placés de chaque côté du carter *c* dans lequel tourne le vilebrequin *d*. La partie montante *f* de l'arbre moteur porte à son extrémité supérieure le volant *g* pourvu d'un bord *h* que l'on peut saisir facilement, et il ne présente aucune aspérité ni manivelle qui soit susceptible de blesser pendant la mise en marche. En outre, sur chaque cylindre est prévu un robinet *e*, de décompression, placé à mi-course, et facilitant la mise en route. La partie descendante de l'arbre moteur, ou arbre de couche est en deux pièces *i*-*j* cette dernière comprenant une partie carrée *k* sur laquelle s'emboîte un manchon *m* à embout carré, solidaire du vilebrequin, de sorte qu'il est possible de régler la longueur totale de cet arbre et d'élever ou d'abaisser l'hélice *n* suivant la hauteur du bateau. Cette opération se fait en desserrant un collier s^1 placé sur l'extrémité fendue d'un tube *s* mentionné plus loin. La partie inférieure *j* de l'arbre de couche porte un pignon *p*, en prise avec un pignon *o* calé sur l'arbre d'hélice *q*. Celui-ci est porté dans une dérive *r* disposée pour tourner sur la partie inférieure *j* de l'arbre de couche, et elle est reliée par un tube télescopique *s* à une roue hélicoïdale *t* placée dans une partie du carter du moteur, en prise avec une vis sans fin *u* dont l'arbre *v* porte à son extrémité le volant de direction ou macaron *x* pour la commande du gouvernail *z*.

Celui-ci fait corps avec la dérive *r*, et la section longitudinale est celle représentée en *y* et y^1 à la fig. 1, c'est-à-dire en forme de fuseau, sans parties saillantes, dans le but de diminuer le plus possible la résistance à l'avancement. Le gouvernail *z* a l'épaisseur d'une simple feuille de tôle.

L'allumage du ou des moteurs est assuré

soit par pile et bobine, soit par magnéto à haute tension. Le dessin se rapporte à ce dernier cas. Sur le volant *g* est fixé un pignon d'angle 2, en prise avec un second pignon 3 qui commande la magnéto. Le refroidissement du moteur est obtenu au moyen d'une pompe à eau dont le corps 4 fait partie de la dérive *r*. Le piston 5 de cette pompe est commandé par un excentrique 6 placé sur l'arbre *q* et faisant par exemple corps avec le pignon d'angle *o*. Ce piston 5 forme une chambre munie de lumières d'entrée d'eau 7 et peut communiquer avec l'eau ambiante par des ouvertures 8 ménagées dans le corps de pompe 4. Un ressort 9, logé dans le corps de pompe tend à abaisser constamment le piston. Un clapet à bille 10 ferme la partie supérieure de la chambre du piston 5, et un autre clapet à bille 11 ferme la partie supérieure du corps de pompe 4, mettant celui-ci en communication avec un raccord 12 sur lequel s'emboîte un tube flexible 13 allant à la chemise de refroidissement du moteur.

L'appareil tel qu'il vient d'être décrit se fixe à l'arrière du bateau ou canot au moyen d'un étrier à vis 14 (fig. 3) pourvu d'une coulisse courbe 15 permettant d'incliner suivant les besoins l'arbre de couche. Le réservoir d'essence pour le moteur est figuré en 16, fig. 3.

Le fonctionnement du dispositif se comprend de lui-même.

Il suffit de dire que lorque le moteur est en marche, la pompe de refroidissement fonctionne d'une façon continue et assure le refroidissement avec de l'eau constamment renouvelée. Le gouvernail *z* est commandé par le volant ou macaron *x* à l'aide de la transmission décrite qui, étant irréversible contribue à faciliter la direction, mieux que dans les dispositifs semblables avec commande du gouvernail par barre franche. L'hélice peut se mettre dans toute position voulue et on pourrait même réaliser la marche arrière en la faisant tourner de 180° sur son pivot. On peut du reste, entre le vilebrequin *d-i* et le manchon *m* intercaler un débrayage avec marche arrière par mouvement différentiel pour les embarcations nécessitant une manœuvre rapide ou pour les moteurs de puissance supérieure.

Les principaux avantages de l'appareil sont les suivants :

La direction irréversible commandée par un macaron; la protection de l'hélice entre les corps étrangers, cette hélice étant placée dans la dérive *r* formant gouvernail; la disposition équilibrée des cylindres moteurs, supprimant toutes vibrations, et le volant sans saillies dangereuses permettant la mise en marche des plus faciles et sans danger de se blesser.

L'appareil se construit en toutes dimensions, pour toutes les forces et peut, si on le désire comprendre un moteur monocylindrique.

RÉSUMÉ :

1° Un dispositif propulseur amovible pour embarcations, spécialement pour canots à rames ou à voile, permettant de les transformer instantanément en canots automobiles, comprenant un moteur, de préférence d'un type équilibré à deux cylindres, actionnant un arbre de couche dont une partie porte un volant, tandis que l'autre, de longueur variable à volonté, commande l'arbre de l'hélice porté par une dérive formant en même temps gouvernail, reliée à son tour à un volant de direction ou macaron par l'intermédiaire d'une transmission irréversible.

2° Un appareil du genre énoncé en 1°, caractérisé plus particulièrement :

a) Par un volant de moteur muni d'un rebord permettant de le saisir facilement et dépourvu de toutes saillies, dans le but de faciliter la mise en marche, et de supprimer tout danger que pourrait présenter cette opération;

b) Par la disposition d'un moteur équilibré supprimant les trépidations de la marche;

c) Par la disposition sur les cylindres du moteur, de robinets de décompression placés à mi-course, dans le but de faciliter la mise en marche;

d) Par la direction irréversible facilitant la conduite du bateau;

e) Par la disposition de l'hélice dans une dérive formant en même temps protecteur de cette hélice et gouvernail;

f) Par une pompe de refroidissement disposée sur la dérive et actionné par l'arbre porte-hélice;

g) Par un étrier de fixation de l'appareil sur le bateau, présentant une coulisse incurvée permettant de donner à l'arbre de couche l'inclinaison voulue.

MARCEL ECHARD.

Par procuration :

SCHWAB.

AUSGEGEBEN
AM 5. DEZEMBER 1921

DEUTSCHES REICH

REICHSPATENTAMT

PATENTSCHRIFT

— № 345103 —

KLASSE 65f GRUPPE 23

Hugo Mandl in Kiel.

Außenbordmotor für Wasserfahrzeuge mit ständig in gleicher Richtung umlaufendem Motor.

Patentiert im Deutschen Reiche vom 22. April 1920 ab

Die Erfindung bezieht sich auf einen Außenbordmotor für Wasserfahrzeuge mit ständig in gleicher Richtung umlaufenden Motor, bei welchem das auf dem inneren Ende der Steuerpinne sitzende Triebrad in ein Zahnrad eingreift, das unmittelbar mit einem die Motorwelle umgebenden Rohre am oberen Ende in fester Verbindung steht, während ein zweites äußeres Rohr als Aufhänge- und Drehpunkt für das Propellergehäuse dient. Hierdurch wird erreicht, daß sich das am unteren Ende der Rohre sitzende Propellergehäuse um 360° drehen

kann. Ferner dient der Zwischenraum zwischen den beiden die Motorwelle umgebenden Rohren dazu, dem Motorzylinder das Kühlwasser zuzuleiten, das durch eine auf der Motorwelle sitzende Flügelpumpe gefördert wird, und das dem Kühlraum des Motorzylinders durch ein den Durchlaß vermittelndes Paßstück, welches außerhalb des Aufhängerohres angeordnet ist, unmittelbar durch ein Abzugsrohr zugeführt wird.

Der Erfindungsgegenstand ist auf der Zeichnung dargestellt, und zwar zeigt

Abb. 1 einen senkrechten Schnitt,

Abb. 2 einen Grundriß und einen Schnitt vom Paßstück und

Abb. 3 einen Grundriß und einen Schnitt von der Flügelpumpe.

Die Erfindung besteht aus dem auf dem inneren Ende der Steuerpinne *a* sitzenden Zahnrad *b*, welches in das Zahnrad b^1 eingreift, das am oberen Ende eines die Motorwelle *k* umgebenden Rohres k^1 sitzt, während das untere Ende des Rohres k^1 mit dem Propellergehäuse *j* fest verbunden ist. Ein zweites, um das Rohr k^1 angeordnetes äußeres Rohr b^2 dient als Aufhänge- und Drehrohr für das Propellergehäuse *j*. Das Rohr b^2 hängt an einem Flansch, welcher auf einem in dem Gehäuse angegossenen Ring *r* aufliegt, während eine Abschlußplatte r^1 eine Aufwärtsbewegung des Rohres b^2 verhindert. Der Zwischenraum zwischen den beiden Rohren k^1 und b^2 dient als Zuleitung für das Kühlwasser, welches oberhalb des Propellergehäuses *j* durch den Kanal *s* in die Flügelpumpe *u* eintritt und durch diese nach oben gedrückt wird. Oben wird alsdann das Kühlwasser durch Ausbohrungen im Rohr b^2 nach dem in der Stopfbüchse *v* des Gehäuseteils *t* eingesetzten Paßstück *w* geleitet und dem Abzugsrohr *y*, welches unmittelbar mit dem Kühlraum in Verbindung steht, zugeführt. Das Paßstück *w* unterscheidet sich von den bekannten Verteilungsringen dadurch, daß das Wasser von einem inneren Ringkanal durch verschiedene Bohrungen hindurch nach einem äußeren Ringkanal, welcher die Verteilung nach dem Abzugsrohr *y* vermittelt, hindurchgeleitet wird.

Für den Vorwärtsgang hat die Steuerpinne eine Einschnappvorrichtung *z*, mittels welcher die Bewegungsrichtung festgestellt werden kann.

Die Motorwelle *k* kann sich in dem Innenrohr k^1 frei und ohne Reibung drehen, unabhängig von der Pressung durch die Stopfbüchse *v*.

Die Vorteile vorliegender Anordnung liegen darin, daß das Propellergehäuse *y* durch Drehung der Ruderpinne um ihre eigene Achse unter Vermittelung der Zahnräder *b* und b^1 nach Belieben um 360° gedreht werden kann, und daß die Wasserzuführung, durch die Anordnung des Paßstückes *w*, unter Wegfall aller losen und verderblichen Teile, wie Schläuche u. dgl., in unmittelbarer Verbindung mit dem Kühlraum des Motorzylinders steht.

Patent-Ansprüche:

1. Außenbordmotor für Wasserfahrzeuge mit ständig in gleicher Richtung umlaufenden Motor, dadurch gekennzeichnet, daß ein auf dem inneren Ende der Steuerpinne sitzendes Triebrad (*b*) in ein Zahnrad (b^1) eingreift, das unmittelbar mit einem die Motorwelle umgebenden Rohre (k^1) am oberen Ende in fester Verbindung steht, wodurch sich das am unteren Ende des Rohres (k^1) sitzende Propellergehäuse um 360° drehen kann, wobei ein äußeres Rohr (b^2) als Aufhänge- und Drehpunkt dient.

2. Außenbordmotor nach Anspruch 1, dadurch gekennzeichnet, daß der Zwischenraum zwischen den beiden die Motorwelle umgebenden Rohren (k^1 und b^2) dazu dient, dem Motorzylinder das Kühlwasser zuzuleiten, das durch eine auf der Motorwelle sitzende Flügelpumpe (*u*) gefördert wird.

3. Außenbordmotor nach Anspruch 1 und 2, dadurch gekennzeichnet, daß die Verteilung des Kühlwassers durch ein den Durchlaß zwischen dem ringförmigen Rohrzwischenraum und dem zum Motorzylinder führenden Abzugsrohr (*y*) vermittelndes Paßstück (*w*) bewirkt wird, und das Abzugsrohr (*y*) in unmittelbarer Verbindung mit dem Kühlraum des Motorzylinders steht.

Hierzu 1 Blatt Zeichnungen.

Zu der Patentschrift **345103**

Kl. 65f Gr. 23

603

Abb. 1.

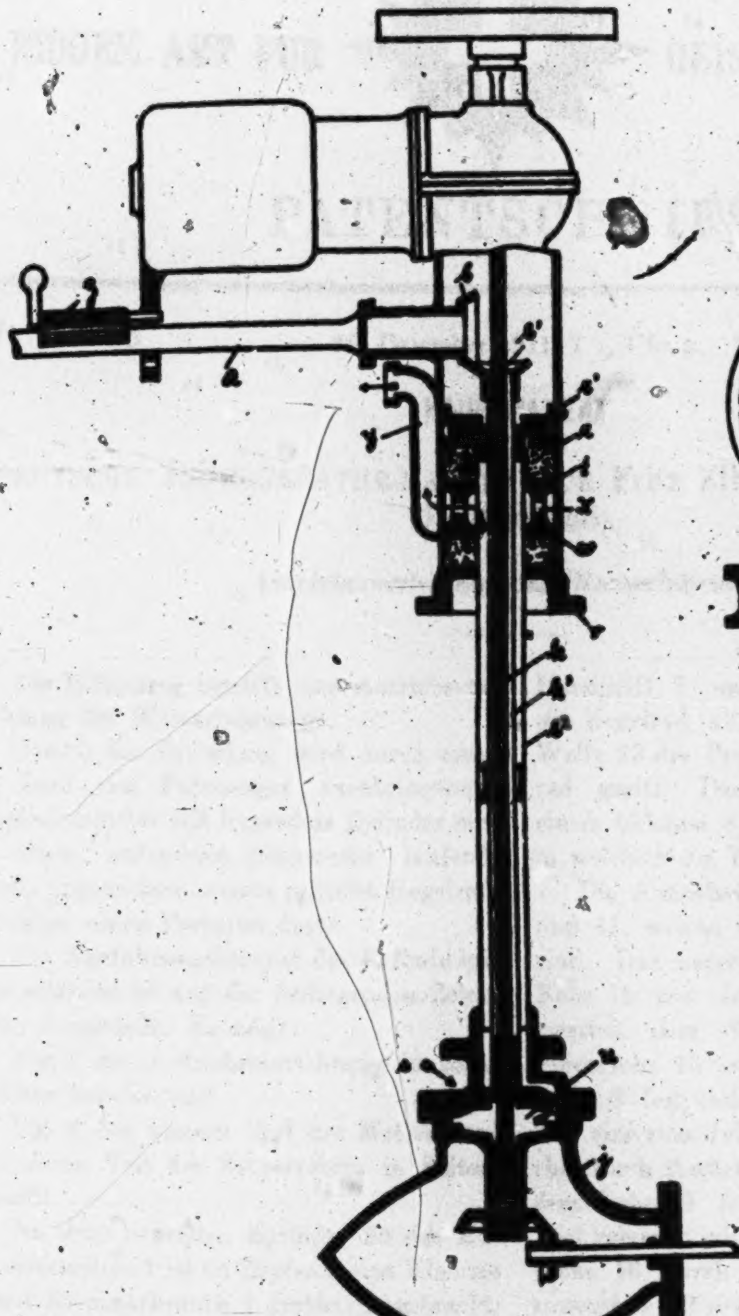


Abb. 2.

Abb. 3.

SCHWEIZERISCHE EIDGENOSSENSCHAFT

605

EIDGEN. AMT FÜR GEISTIGES EIGENTUM

PATENTSCHRIFT

Nr. 58818 — 26. Dezember 1911, 7 ½ Uhr p. — Klasse 128 e

HAUPTPATENT

DEUTSCHE ANGELGERÄTHE-MANUFACTUR Fritz ZIEGENSPECK, Berlin (Deutschland).

Antriebsvorrichtung für Wasserfahrzeuge

Die Erfindung betrifft eine Antriebsvorrichtung für Wasserfahrzeuge.

Gemäß der Erfindung wird durch einen an Bord des Fahrzeuges anzubringenden Explosionsmotor mit liegendem Zylinder eine in einem aufrechten Steuerrohr laufende Welle angetrieben, welche mittelst Kegelradgetriebes einen Propeller dreht.

Ein Ausführungsbeispiel des Erfindungsgegenstandes ist auf der beiliegenden Zeichnung dargestellt. Es zeigt:

Fig. 1 die Antriebsvorrichtung in senkrechtem Schnitt, und

Fig. 2 den hintern Teil des Motors und den obern Teil des Steuerrohres in Seitenansicht.

An dem liegenden Zylinder 20 des Explosionsmotors 1 ist an Zapfen 2 eine Klemme 3 mit Klemmschraube 4 drehbar angebracht, mittelst welcher die Antriebsvorrichtung an dem Bordrand des Wasserfahrzeuges befestigt werden kann. Von der Schubstange des Motors wird die aufrechte Welle 5 angetrieben, an deren oberem Ende ein Schwungrad 6 mit einem zum Anwerfen des Motors dienenden Handgriff 7 und an deren unterem Ende ein Kegelrad sitzt, welches in ein auf der Welle 29 des Propellers 9 befestigtes Kegelrad greift. Das Kegelradgetriebe ist in einem Gehäuse 8 wasserdicht eingeschlossen, in welchem die Welle 9 gelagert ist.

Die Antriebswelle 5 läuft in Lagern 10 und 11, welche am Motorzylinder befestigt sind. Das untere Lager 11 ist mit einem Rohr 12 fest vereinigt, welches in einem zweiten, dem Steuerrohr 13, steckt. Das Steuerrohr 13 ist mit dem erwähnten Gehäuse 8 fest verbunden und trägt am obern Teil eine zum Teil geschlitzte Hülse 14, welche durch Anziehen einer Schraube 15 auf dem Rohr 13 festgeklemmt werden kann. Fest vereinigt mit der Hülse 14 ist die Steuerpinne 16, durch welche das Steuerrohr 13 zusammen mit dem Gehäuse 8 und dem Propeller 9 gedreht werden kann. Die Steuerpinne wird nach dem Anbringen der Antriebsvorrichtung am Boot durch den Bootrand gestützt. Auf das Steuerrohr 13 ist ferner eine Hülse 17 gesetzt, durch welche seitlich des Rohres 13 eine an der Klemme 3

befestigte Bogenschiene 18 hindurchgeht. Hierdurch ist es möglich, den Neigungswinkel der Antriebswelle 5 in bezug auf die Klemme 3 und den Bordrand einzustellen. Eine Klemmschraube 19 dient zum Feststellen der Teile in der gewünschten Lage.

Da die Antriebswelle 5, wie aus Fig. 1 erkennbar ist, aus zwei ineinanderschiebbaren, mittelst Nut und Feder gekuppelten Teilen besteht, so läßt sich nach Lösen der Schraube 15 das Steuerrohr 13 auf dem innern Rohr 12 verschieben und so die Antriebswelle 5 zu dem Fahrzeug passend in ihrer Länge einstellen.

Auf dem liegenden Motorzylinder 20 ist ein Bosch-Magnetzündapparat 21 angebracht, von dem ein Kabel 22 zur Zündkerze 23 führt. Der Magnetzündapparat 21 wird von der Antriebswelle 5 gesteuert. Zur Steuerung dient eine Stange 24, die durch einen am Schwungrad 6 befestigten Nocken 26, welcher auf eine an der Stange 24 angebrachte Rolle wirkt, hin- und herbewegt wird. Der Nocken 26 ist dabei so breit gehalten und derart gestaltet, daß er bei Rechts- und Linksgang des Schwungrades eine gleiche zwangsläufige Frühzündung am Zündapparat bewirkt. Der Motor kann daher bei Rechts- oder Linksandrehen gleich gut arbeiten, was bei Wasserfahrzeugen von wesentlicher Bedeutung ist.

Das eine Kegelrad des im Gehäuse 8 angebrachten Getriebes trägt einen Exzenter 27, der die Kühlwasserpumpe 28 treibt.

Der Propeller 9 läuft in einer Aussparung des Ruderblattes 30, das oben am Steuerrohr 13 und unten am Gehäuse 8 befestigt ist und auf diese Art einen Schutz des Propellers nach hinten, nach oben und nach unten bildet.

31 ist ein von dem hintern Teil des Motorzylinders 20 getragener Benzinbehälter, unter dem neben dem Vergaser 32 und dem Benzinablauf 33 der Auspuff 34 angebracht ist, der ebenso wie der Benzinbehälter 31 zwecks Raumersparnis um den hintern Teil des Motors herumgeführt ist.

Durch die Pinne 16 wird zwecks Steuerung des Fahrzeuges der Propeller 9 gemeinsam mit dem Ruderblatt 30 eingestellt und auf diese Weise eine erhöhte Steuerwirkung erzielt.

PATENTANSPRUCH:

Antriebsvorrichtung für Wasserfahrzeuge, dadurch gekennzeichnet, daß durch einen an Bord des Fahrzeuges anzubringenden Explosionsmotor mit liegendem Zylinder eine in einem aufrechten Steuerrohr laufende Welle angetrieben wird, die mittelst Kegelradgetriebes einen Propeller dreht.

UNTERANSPRÜCHE:

1. Antriebsvorrichtung für Wasserfahrzeuge nach dem Patentanspruch, dadurch gekennzeichnet, daß ein in einer Aussparung den Propeller aufnehmendes Ruderblatt am Steuerrohr und an einem mit dem Steuerrohr verbundenen Gehäuse des Kegelradgetriebes befestigt ist.
2. Antriebsvorrichtung für Wasserfahrzeuge nach dem Patentanspruch, dadurch gekennzeichnet, daß auf dem Zylinder des Motors ein Magnetzündapparat angebracht ist.

DEUTSCHE ANGELGERÄTHE-MANUFACTUR
Fritz ZIEGENSPECK.
Vertreter: E. BLUM & Co., Zürich.

Deutsche Angelgeräthe-Manufactur
Fritz Ziegenspeck

Patent Nr. 58818
1 Blatt

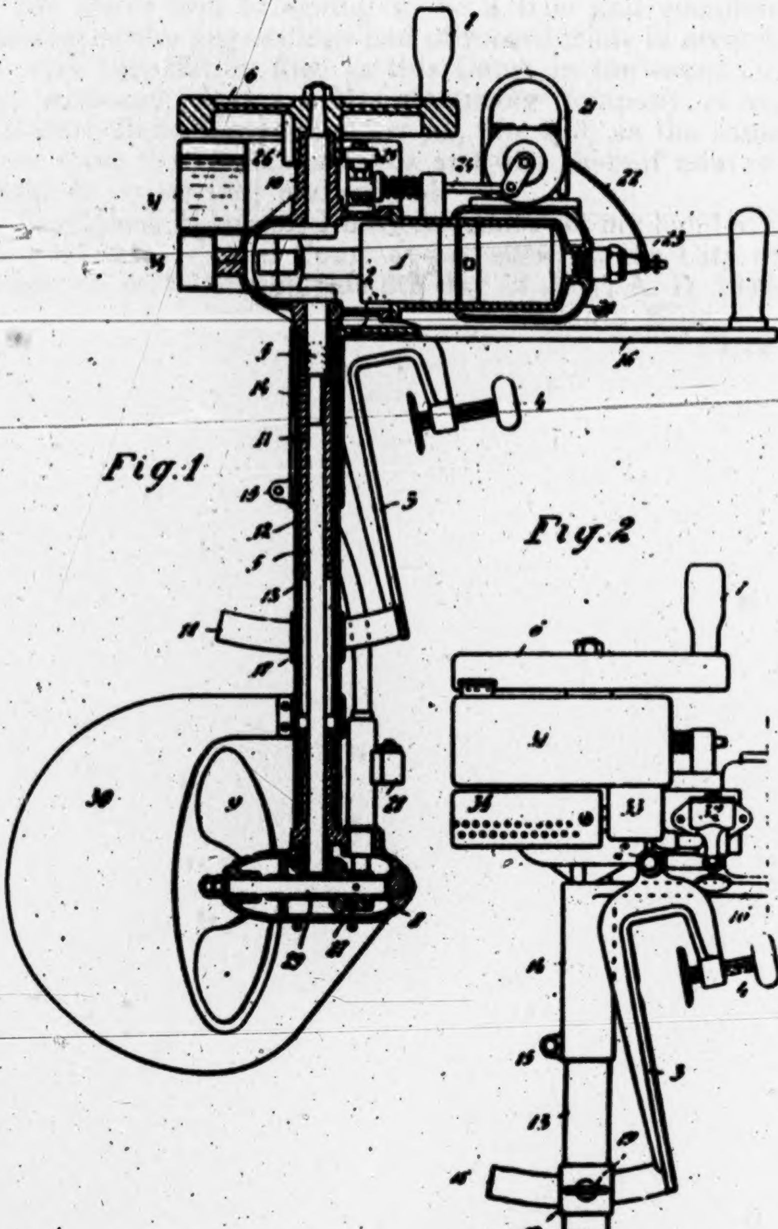


Fig. 1

Fig. 2

663 Northern District of Illinois }
Eastern Division } ss.

I, Hoyt King, Clerk of the District Court of the United States for the Northern District of Illinois, do hereby certify the above and foregoing to be a true and complete transcript of the proceedings had of record made in accordance with Stipulation filed in this Court in the cause entitled Outboard, Marine & Manufacturing Company, et al., *vs.* Muncie Gear Works, Inc., et al., No. 273, as the same appear from the original records and files thereof now remaining in my custody and control.

In Testimony Whereof, I have hereunto set my hand and affixed the seal of said Court at my office, in the City of Chicago, in said District, this 6th day of July, A. D. 1940.

Hoyt King,
(Seal) *Clerk.*

United States Circuit Court of Appeals

For the Seventh Circuit.

I, Kenneth J. Carrick, Clerk of the United States Circuit Court of Appeals for the Seventh Circuit, do hereby certify that the foregoing printed pages contain a true copy of the printed record, printed under my supervision and filed on the thirteenth day of August, 1940, in the following entitled cause:

Cause No. 7388

Outboard Marine & Manufacturing Company, *et al.*,
Plaintiffs-Appellants,
vs.
Muncie Gear Works, Inc.,
Defendants-Appellees,

as the same remains upon the files and records of the United States Circuit Court of Appeals for the Seventh Circuit.

In Testimony Whereof I hereunto subscribe my name and affix the seal of said United States Circuit Court of Appeals for the Seventh Circuit, at the City of Chicago, this 16th day of July, A. D. 1941.

Kenneth J. Carrick,
(Seal) *Clerk of the United States Circuit Court of Appeals for the Seventh Circuit.*

At a regular term of the United States Circuit Court of Appeals for the Seventh Circuit held in the City of Chicago and begun on the third day of October, in the year of our Lord one thousand nine hundred and thirty-nine and of our Independence the one hundred and sixty-fourth.

Outboard Marine & Manufacturing Company and Johnson Brothers Engineering Corporations, *Plaintiffs-Appellants,* 7388 *vs.* Muncie Gear Works, Inc., and Bruns & Collins, Inc., *Defendants-Appellees.*	**Appeal from the District Court of the United States for the Northern District of Illinois, Eastern Division.**

And, to-wit: On the twenty-ninth day of January, 1941, there was filed in the office of the Clerk of this Court, the opinion of the Court, which said opinion is in the words and figures following, to-wit:

IN THE UNITED STATES CIRCUIT COURT OF APPEALS

For the Seventh Circuit.

No. 7388. October Term, 1940, January Session, 1941.

OUTBOARD MARINE & MANUFACTURING COMPANY and JOHNSON BROTHERS ENGINEERING CORPORATION, *Plaintiffs-Appellants,*

vs.

MUNCIE GEAR WORKS, INC., and BRUNS & COLLINS, INC., *Defendants-Appellees.*

Appeal from the District Court of the United States for the Northern District of Illinois, Eastern Division.

January 29, 1941.

Before EVANS and TREANOR, *Circuit Judges,* and BRIGGLE, *District Judge.*

EVANS, *Circuit Judge.* This appeal involves six patents which the District Court disposed of by consolidating two suits and hearing them together. Of the six patents, plaintiff, Outboard Marine & Manufacturing Company, is the owner of three, Nos. 1,786,835; 1,869,749; 1,875,912; and is the exclusive licensee of the remaining three, which are owned by Johnson Brothers Engineering Corporation, a co-plaintiff. The latter three are Nos. 1,716,962; 1,763,970; and 2,067,533. They all deal with phases of outboard motors in which field plaintiffs appear to be the leaders.

The Outboard M. & M. Co. operates two separate plants, one known as the Evinrude Motors Division, located at Milwaukee, Wisconsin, and the other, the Johnson Motors Division at Waukegan, Illinois. Each has its own separate engineering and production staff, and the output of each plant is large. It asserts responsibility for most of the development of the outboard motor industry and contends that defendants are endeavoring to enter the field by copy-

ing plaintiffs' motors and improvements and appropriating the results of the long continued and costly research efforts.

The more specific legal questions raised by the record, to which we must confine our attention, are asserted validity of certain improvement patents and the asserted avoidance of infringement by defendants' structure, wherein it appears defendants have made a studied effort to avoid a narrow patent through a slightly changed mechanism. This situation necessitates an ascertainment of the place of the patent in the art and the correlative inquiry as to the extent of the mechanical equivalents we should allow.

The court found claims 11, 12, 13, and 14 of Johnson patent, No. 1,716,962, were invalid because aggregations and also that claims 11 and 12 of said patent were not infringed and that claims 13 and 14 would be infringed if they were valid.

The court also found claims 3 and 14 of Johnson patent, No. 1,763,970, are invalid because aggregations. It also found them not infringed.

It found claim 19 of the Pierce Reissue patent No. 18,118, invalid, because of the prior art and also infringed, if valid.

It found claim 16 of No. 1,875,912 was not infringed by defendants' structure. Claims 1, 4, 5, 8, 9, and 10 of Evinrude No. 1,786,835, were held invalid because aggregations. Claims 5 and 10 of said patent were not infringed, and claims 1, 4, 8, and 9 were infringed, if valid.

It also found claims 1 and 2 of the Irgens patent, No. 1,869,749, to be not infringed. It also held the Johnson patent, No. 2,067,533, invalid.

By separating and dealing with each claim in each patent and making findings both on the validity and the infringement of each claim, the District Court has greatly lessened our burden.

While our purpose is not to avoid writing opinions of necessity of great length, we are convinced that elaboration of views may be unnecessary where specific and direct findings on individual claims by the District Court are in full harmony with like findings by us made, after an independent study, and the issue before both courts is a factual one.

Plaintiffs' counsel call our attention to the relative importance of the various claims, admitting that some patents cover minor and rather unimportant improvements which are narrow in scope. Quite unjustified would we be to devote a great deal of time to them, when we are clearly convinced and our conclusion is confirmed by the decision of the trial court.

Such a patent is the Johnson patent, No. 2,067,533, covering a "Spark Plug Cover." The claims in issue covered an exposed spark plug on an internal combustion engine with the novel claim element consisting of a "normally closed cover therefor hinged to the engine for making a tight connection with its outer surface and movable to cover and uncover the spark plug."

We have no hesitancy in holding that providing a cover for a spark plug, which cover can be moved so as to shield the spark plug, is not invention, irrespective of any prior art.

Likewise we will dispose of the non-infringement defense of the defendants to claims 3 and 14 of patent No. 1,763,970, entitled "Stream Line Construction," without elaborating our views. We will not deal with the validity of these claims in view of our conclusion that the accused structure does not infringe. Claim 3 describes a propeller wherein the "said casing having a portion projecting above the water level of substantially symmetrical knife-edge or wedge-like stream line contour and having a portion below said anti-cavitation plate, the front vertical edge of which is of substantially bluntly rounded stream line contour and the trailing edge of which is substantially knife-edge or wedge-like stream line contour."

We are satisfied that the front vertical edge of the accused device is not of "substantially bluntly rounded stream line contour." As the trial judge observed, "It is knife edge as that term is used in the art."

Patent No. 1,875,912 covers a cooling system for marine engines, and only claim 16 is involved. The court found this claim was not infringed. While we doubt the soundness of this finding, we are of the opinion that the defense of invalidity must be sustained.

Novelty, if any, in the combination of this claim, lies in the shape of the opening which provides a water inlet of sufficient capacity and so located with reference to the

stream line surface that it does not extend to any portion of the stream line in which it might be subject to increased pressure or vacuum.* In other words, Arndt, the inventor, so shaped his inlet opening as to make it stay within the confines of a narrow upright surface. This was accomplished by extending the inlet vertically along the forward apex of his stream line lower unit. Substituting an inlet which is transversely narrow and vertically elongated for a somewhat circular one, does not, in this art, pass beyond the skill of the mechanic. We therefore hold the claim invalid.

Patent No. 1,869,749, to Irgens, covering an "Exhaust Tube for Internal Combustion Engines" presents two claims which the court found were not infringed.

The asserted patentable novelty of the combination consists of a tapering exhaust pipe having a submersible outlet movable in accordance with the operation of the engine and directed rearwardly, "*the tapering form of said pipe being adapted to destroy its resonance to pulsation frequencies.*" The second claim describes the novel feature as having an exhaust pipe leading from the manifold and of such dimensions as to be resonant to the frequency of the pulsations occasioned therein by engine exhaust, the pipe having a tapered form destructive of such pulsation.

After the claim had been rejected in the Patent Office, the Board of Appeals allowed the claim in the following language:

"The mere tapering of the pipes is deemed insufficient to obtain the function desired. It is obviously necessary to design the pipe of proper dimensions. Applicant gives certain dimensions in his specifications. The exact length of the tube is not given although it may be fairly well estimated from the drawing when the pipe is compared with the boat illustrated."

"It is considered that none of the claims except 7, 8, and 9, are sufficiently specific to define over the prior art for the reasons stated by the Examiner. Such claims as the first to the fourth, merely relate to tapering the pipe. Claims 5 and 6 state dimensions of cross sections of the pipe, but state no length of the pipe used."

From the foregoing, it is apparent that it was not patentable to cover merely a tapering pipe as such. To be

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* We use counsel's language in substance.

valid, the claim must describe an exhaust pipe of a particular type. Only the pipe described in the above-quoted portions of the claim possessed patentable novelty. But the evidence fails to show that the tapering pipe of the accused structure was of such dimensions "as to be resonant to the frequencies of the pulsations occasioned therein by the engine exhaust." The burden was on plaintiff. Proof that defendant used a tapered pipe is insufficient.

A tapering pipe, as such, was not the subject of a valid patent, and claims drawn thereon were rejected. The allowed claims may not now be construed as to cover tapered exhaust pipes without adding other specific limiting characteristics, such, for example, as to be of such dimensions as to destroy its resonance to pulsation frequencies.

Somewhat complicated* and more difficult to appraise its place and value in this art is patent No. 1,716,962, for a "Water Propulsion Device." It concerns itself with the construction of the lower unit of an outboard motor, and its object is to avoid what in this art is known as cavitation, the avoidance of which was desirable, if not necessary, in the construction and successful operation of high-powered outboard motors.

When a power driven propeller turns in a body of water in which it is immersed, its action tends to drive the water rearwardly. The reaction is what propels the boat. A vacuum near the propeller results, into which air passes, because air moves more rapidly than the water. The invention covered by this patent tenders a proposed solution of this cavitation difficulty.

In high-powered motors the problem of the engineer

* "12. A propulsion device for water craft having a stationary support carrying a bearing, a drive shaft casing mounted to turn in said bearing, a motor mounted on the upper end of said drive shaft casing with its drive shaft disposed within the drive shaft casing and said shaft passing downwardly therethrough, a housing mounted on the lower portion of the drive shaft casing and turnable therewith for steering, said housing being formed with a substantially horizontal barrel-like portion, a propeller shaft mounted within said barrel-like portion and having a driving connection with the motor drive shaft, a propeller on said propeller shaft, said housing having an anti-cavitation plate extending rearwardly therefrom overlying the path of forward travel of the propeller blades, said housing having unbroken outer wall surfaces at each side extending upwardly from the said barrel-like portion to said plate and from said plate upwardly a substantial distance to the top of the housing, and said housing having a substantially vertical internal passage leading to the water jacket of the engine, said passage opening below the normal water level."

was to avoid or lessen cavitation. We need not concern ourselves with, or enlarge upon, the utility of such an invention, for it is obvious that whether used on high-powered racing boats only, or whether the benefits are large or small, any successful effort which lessens cavitation, evidences utility.

The presumption which attends the grant of this patent is strengthened by its extensive use, the promptness with which it was accepted, and a decision of a court which upheld it. *Johnson Bros. Engineering Co.* v. *Caille,* 8 F. Supp. 198. This presumption has been greatly weakened, however, by the decision of the District Court in the instant case.

Of interest is its record in litigation with one loss and one victory, as bearing on the existence of *doubt* as to validity. It is only in doubtful cases that we may look to its acceptance by the users and its adoption by manufacturers. Plaintiff contends that it has at least established doubt as to validity and therefore we should examine the evidence of prompt and extensive use and the tribute paid it by the action of competitors toward it, all of which is impressive.

We are convinced that there is patentable novelty in the four claims of the combination in issue. This, other facts appearing, may spell invention, even if all the elements are old ones. The anti-cavitation plate may well have been old, but as an old element, in a new combination, it was, in cooperation with other elements, what gave to this motor its increased efficiency.

There was, also, it seems to us, cooperative relationship between the anti-cavitation plate and stream-lining of a portion of the outboard motor structure.

We must deny anticipation by the prior art, although such prior art undoubtedly weakened the claim of patentable novelty. There was no anticipation of the combination described in these claims. There were old elements in the combination. For the purpose of the argument it may be conceded that all of the elements were old. But significant is the fact that all the old elements had never before appeared in one combination. The combination was therefore new, although made up of old elements.

The fact that the inventor made use of elements each of which was old, although not sufficient to establish an-

ticipation, does bear heavily against him on the issue of patentable növelty. This is the debatable issue which this patent presents. We resolve it in appellants' favor, (a) because it so appeals to us, as involving more than mechanical skill, and (b) because of the extensive public use—its commercial success and the recognition which has been given it by competitors and users.

The defense of aggregation falls in the face of what is established by testimony, and confirmed by our study of the operation of water propulsion devices in outboard motors.

If the two elements which are the asserted novel features of this invention cooperate in their action, the defense of aggregation fails. Accepting the most liberal construction of the term "aggregation," it could not in this case stand as a bar to plaintiffs' structure evidenced by claims 11, 12, 13, and 14.

In respect to infringement of these claims, the court found, and we agree with the findings, that claims 13 and 14 were infringed. Claims 11 and 12, however, were found to be not infringed, although the District Court's opinion was expressed in this language:

"I think probably the defendant has the better of that argument."

Infringement of claims 11 and 12 turns upon whether the defendants' accused motor is mounted on the upper end of the drive shaft casing. Construing this language as we believe it should be construed, it is so mounted. We are convinced that claims 11, 12, 13, and 14 of Patent No. 1,716,962 are valid and infringed.

Patent No. 1,786,835, deals with an altogether different problem in outboard motors. It covers a water cooling system specially adapted for outboard motors.

Six claims, 1, 4, 5, 8, 9, and 10, are involved. The court found 5 and 10 to be not infringed, and claims 1, 4, 8, and 9 to be infringed, if the patent be upheld. The court concluded that all claims must fall because void for aggregation.

While not agreeing with the District Court that the defense of aggregation defeats this patent, yet we do not find novelty in the structure over the prior art. What the inventor did, was not more than we should expect of a

mechanic who was skilled in this art. Defendants' copying the structure has made us pause, for in this copying there was a real tribute, a recognition of high skill, if not of genius. But defendants' conduct in copying plaintiffs' motor is by no means conclusive. We must view the patent from the standpoint of the public, not merely as a case against one who was appropriating a competitor's property.

Notwithstanding our doubts, we hold the claims of this patent invalid, because lacking in patentable novelty. This conclusion makes it unnecessary for us to pass on the alleged (and denied) infringement or to discuss the weakness of the specifications in failing to show the features here charged to be novel.

The decree is affirmed, except as to that part which deals with patent No. 1,716,962. As to it, the decree is reversed with directions to enter the usual decree in such a case, enjoining defendants from further infringing, directing an accounting for the past infringements, and for costs and such other relief as may be proper.

The costs of this appeal shall be borne equally by the parties.

Endorsed: Filed Jan. 29, 1941. Kenneth J. Carrick, Clerk.

And on the same day, to-wit: On the twenty-ninth day of January, 1941, the following further proceedings were had and entered of record, to-wit:

Wednesday, January 29, 1941.

Court met pursuant to adjournment.

Before:

Hon. Evan A. Evans, Circuit Judge.

Hon. Walter E. Treanor, Circuit Judge.

Hon. Charles G. Briggle, District Judge.

Outboard Marine & Manufacturing Company, *et al.*, *Plaintiffs-Appellants*, 7388 *vs.* Muncie Gear Works, Inc., *et al.*, *Defendants-Appellees.*	**Appeal from the District Court of the United States for the Northern District of Illinois, Eastern Division.**

This cause came on to be heard on the transcript of the record from the District Court of the United States for the Northern District of Illinois, Eastern Division, and was argued by counsel.

On consideration whereof, it is ordered, adjudged and decreed by this Court that the decree of the said District Court in this cause appealed from be, and the same is hereby, affirmed, except as to that part which deals with patent No. 1,716,962, as to which it is ordered, adjudged and decreed that the said decree appealed from be, and it is hereby, reversed; and that this cause be remanded to said District Court, with directions to enter the usual decree in such a case, enjoining defendants from further infringing, directing an accounting for the past infringements, and for costs and such other relief as may be proper.

It is further ordered, adjudged and decreed that the costs of this appeal shall be borne equally by the parties.

And afterwards, to-wit: On the thirteenth day of February, 1941, there was filed in the office of the Clerk of this Court, a petition for a rehearing by appellees which said petition for rehearing is not copied here.

And afterwards, to-wit: On the eighteenth day of February, 1941, there was filed in the office of the Clerk of this Court, a petition for a rehearing by appellants which said petition for rehearing is not copied here.

And afterwards, to-wit: On the twentieth day of February, 1941, there was filed in the office of the Clerk of this Court, an answer to appellees' petition for rehearing, which said answer is not copied here.

And afterwards, to-wit: On the twenty-eighth day of February, 1941, there was filed in the office of the Clerk of this Court, an answer of appellees to appellants' petition for a rehearing, which said answer is not copied here.

And afterwards, to-wit: On the sixteenth day of May, 1941, the following further proceedings were had and entered of record, to-wit:

Friday, May 16, 1941.

Court met pursuant to adjournment.

Before:

Hon. Evan A. Evans, Circuit Judge.
Hon. Charles G. Briggle, District Judge.

Outboard Marine & Manufacturing Company, *et al.*,
Plaintiffs-Appellants,
7388 *vs.*
Muncie Gear Works, Inc., *et al.*,
Defendants-Appellees.

Appeal from the District Court of the United States for the Northern District of Illinois, Eastern Division.

It is ordered by the Court that the petitions for rehearing filed herein by counsel for appellants and by counsel for appellees, be, and they are hereby, denied.

And afterwards, to-wit: On the seventh day of July, 1941, there was filed in the office of the Clerk of this Court a stipulated designation of record, which said designation is in the words and figures following, to-wit:

IN THE UNITED STATES CIRCUIT COURT OF APPEALS

For the Seventh Circuit.

Outboard Marine & Manufacturing Co., *et al.*, *Plaintiffs-Appellants*, *vs.* Muncie Gear Works, Inc., and Bruns & Collins, Inc., *Defendants-Appellees.*	No. 7388.

STIPULATED DESIGNATION OF RECORD ON PETITION TO THE UNITED STATES SUPREME COURT FOR CERTIORARI.

To the Clerk of the United States Circuit Court of Appeals for the Seventh Circuit:

Please prepare, as soon as possible, in accordance with Rule 38 of the United States Supreme Court, a certified transcript of the record of the above-entitled case, to be submitted to said Court in the matter of Petition of Defendants-Appellees and cross petition of Plaintiff-Appellant, Outboard Marine and Manufacturing Company for certiorari, including the following documents:

1. The opinion of the Circuit Court of Appeals.
2. The judgment.
3. References to filing Petitions and Answers on matter of rehearing.
4. The Order of May 16, 1941 denying Petition for Rehearing.
5. A copy of this Stipulation.

Chas. W. Rummler,
Attorney for Defendants-Appellees.
Geo. L. Wilkinson,
Attorney for Plaintiffs-Appellants.

Dated July 7, 1941.

Endorsed: Filed July 7, 1941. Kenneth J. Carrick, Clerk.

UNITED STATES CIRCUIT COURT OF APPEALS

For the Seventh Circuit.

I, Kenneth J. Carrick, Clerk of the United States Circuit Court of Appeals for the Seventh Circuit, do hereby certify that the foregoing printed pages contain a true copy of the proceedings had and papers filed made in accordance with the stipulated designation filed on the seventh day of July, 1941, in the following entitled cause:

Cause No. 7388

Outboard Marine & Manufacturing Company, *et al.*,
Plaintiffs-Appellants,
vs.
Muncie Gear Works, Inc., *et al.*,
Defendants-Appellees,

as the same remains upon the files and records of the United States Circuit Court of Appeals for the Seventh Circuit.

In Testimony Whereof I hereunto subscribe my name and affix the seal of said United States Circuit Court of Appeals for the Seventh Circuit, at the City of Chicago, this 16th day of July, A. D. 1941.

Kenneth J. Carrick,
(Seal) *Clerk of the United States Circuit Court of Appeals for the Seventh Circuit.*

SUPREME COURT OF THE UNITED STATES

ORDER ALLOWING CERTIORARI—Filed October 13, 1941

The petition herein for a writ of certiorari to the United States Circuit Court of Appeals for the Seventh Circuit is granted.

And it is further ordered that the duly certified copy of the transcript of the proceedings below which accompanied the petition shall be treated as though filed in response to such writ.